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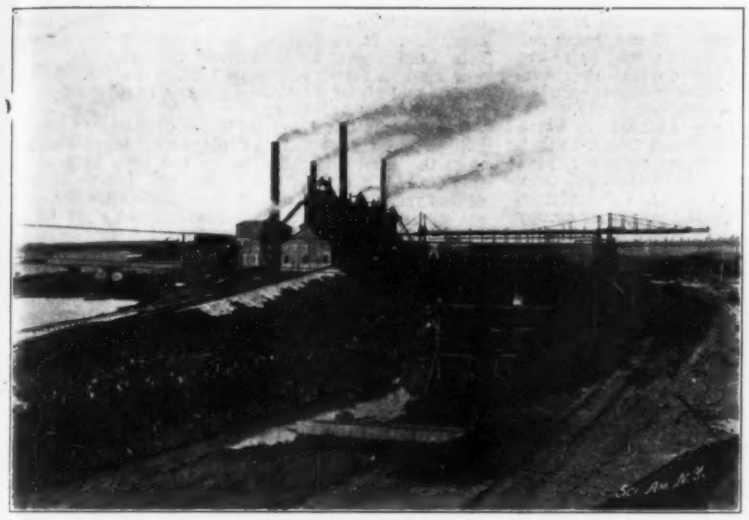
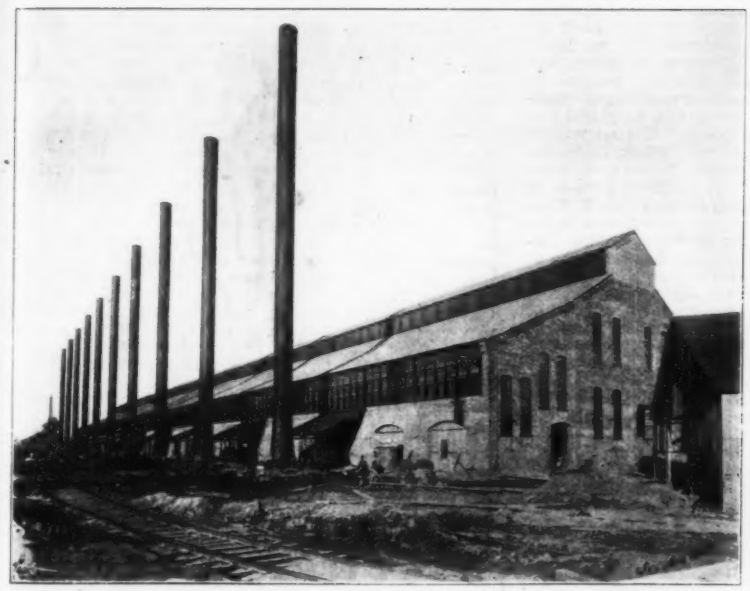
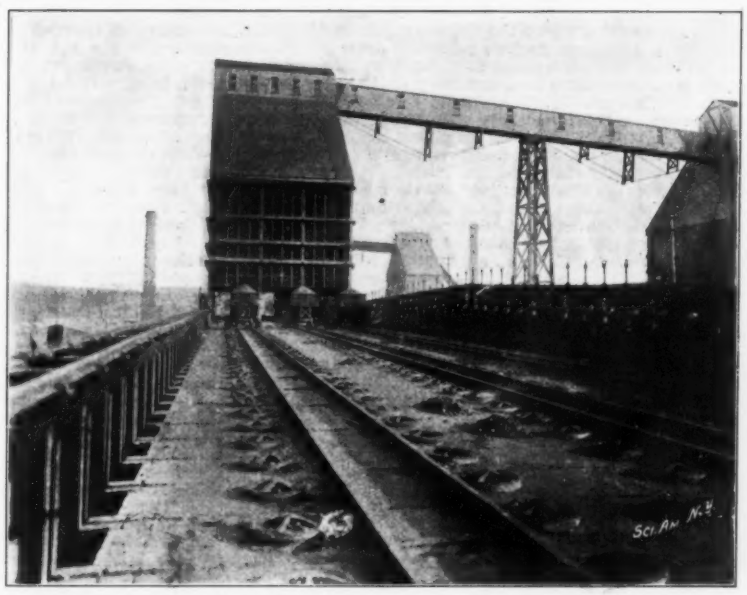


BLAST FURNACES, BRIDGE TROLLEY, AND ORE YARD.

SHIPPING PIERS AND WATER FRONT.

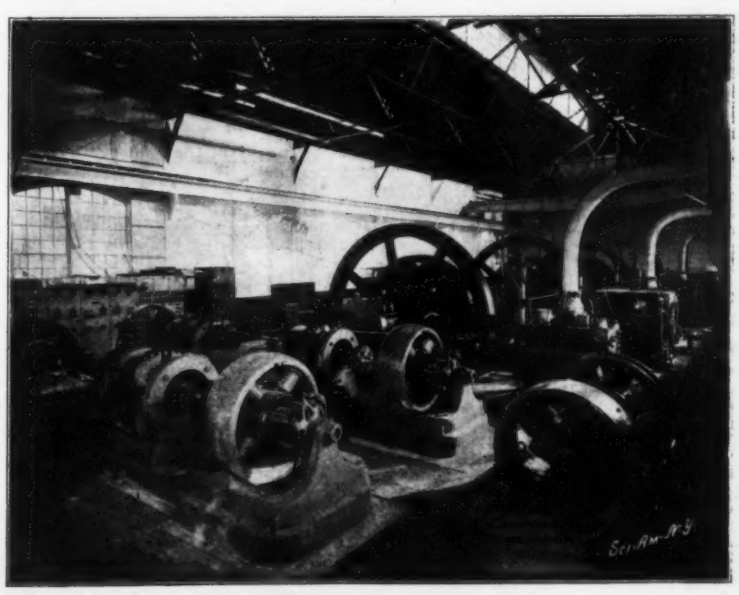


THE OPEN-HEARTH PLANT.



ROOF OF COKE OVENS, SHOWING TRACKS AND CARS FOR CHARGING SAME.

BOILER HOUSE, SHOWING THE LARGE PIPES THAT BRING THE GASES FROM THE BLAST FURNACES TO THE BOILER FURNACES.



INTERIOR OF ELECTRIC POWER HOUSE.

A NEW CANADIAN IRON AND STEEL PLANT.

A NEW CANADIAN IRON AND STEEL PLANT.

By WALDON FAWCETT.

THE opening years of the new century have witnessed the establishment at Cape Breton, Nova Scotia—the "front door of Canada" it has been denominated—of an iron and steel manufacturing enterprise which it is claimed will inaugurate a new industrial era in the northerly section of America. This new undertaking, which embraces not only all the varied activities attendant upon the mining of iron ore and its transformation into iron and steel, but even the mining of coal, the process of coking, and the securance of limestone, is under conduct by the Dominion Iron and Steel Company, a corporation with an authorized capital stock of $15,000,000. This company has acquired by purchase iron ore property on Great Bell Island in Conception Bay, Newfoundland, and limestone quarries on West Bay of the Bras d'Or lakes, but the administrative center and the manufacturing plant proper is located at the town of Sydney, Nova Scotia—a locality which, in the opinion of the promoters of the present enterprise, is the most favorable situation in the world for an iron industry.

Great Bell Island, the scene of the ore deposits of the Dominion Company, is about thirty-five miles from St. John's, Newfoundland, and some four hundred miles by sea from the manufacturing plant at Sydney. The island is eight miles in length and two in breadth, and exposed on the cliffs of its northern side are five beds of ore, although three of them are so limited in extent as to possess little commercial value. The two others constitute the Wabana mine, and of these the Dominion Iron and Steel Company is in possession of the lower or more extensive section, having paid for this holding the sum of $1,000,000.

Experts have pronounced the Wabana one of the most remarkable iron mines in the world. The ore bed consists of small regular blocks of red hematite, most of them about four inches long, two inches wide and two inches thick. These blocks are piled most compactly, making a bed of ore of an average thickness of eight feet extending over an area of 817½ acres. The ore crops out at the surface, and underground operations are not required. In fact, the ore is shoveled directly into cars on the same general plan that is employed in the famous "open pit" mines of the Lake Superior iron-mining district. The ore runs about 54 per cent iron, and it is estimated that the mine taken over by the Dominion Company contains about 28,000,000 tons above sea level, in addition to a much larger quantity in the lower beds.

The north side of Great Bell Island, where the ore beds are located, is exposed to northern winds; but on the opposite side, where the shipping pier is located, there is a very good harbor, perfectly sheltered from the winds, and with a depth of water ranging from 48 to 84 feet. The mine is connected with the pier by a double-track tramway, which is of two-foot gage and two miles in length, and is operated by an endless steel cable 15-16ths of an inch in diameter. About four hundred cars are employed. There are ten pockets of 200 tons capacity each, and the height of the dock, 90 feet, enables a discharge into steamers by gravity. The chutes for this purpose descend at an angle of 40 degs. and are moved by a counterbalanced winch, the operation of which is easily controlled by one man. The cars are dumped by an automatic tipple, upset by the weight of the loaded car, and returned to an upright position by cast-iron counterbalance weights hung upon a shaft beneath the floor. In loading a steamer 200 tons have been discharged from one pocket in ten minutes. About 6,000 tons of ore is the daily mining capacity, and this can readily be handled at the shipping docks. It is claimed that for many years to come the cost of mining and loading on vessels will not exceed fifty cents a ton.

The fuel resources of the new Canadian enterprise are most extensive. The Sydney coal field, which is, of course, adjacent to the manufacturing site, occupies an area of 200 square miles. This field is owned by the Dominion Coal Company; but an affiliation of interests has enabled the Dominion Iron and Steel Company to secure an option on the lease of this entire property, including not only the coal mines but the Sydney & Louisburg Railroad, the rail line which taps the district, for a term of ninety-nine years on the condition of paying the fixed charges and six per cent annually on the common stock. It will thus be seen that the Canadian iron-makers control areas which contain at a most conservative estimate 2,500,000,000 tons of bituminous coal of a very fair grade. The coking qualities of this fuel have been conclusively demonstrated, and the company has installed at a cost of $1,250,000 a coking plant consisting of four hundred ovens of the Otto-Hoffman by-product type. These ovens, which occupy a most convenient location between the coal mines and the iron works, are ranged in two rows of four batteries, each of which latter contains fifty ovens, and the aggregate capacity is 1,600 tons a day. In conjunction with the condenser house and cistern are the necessary coolers, sieve washers, etc., for cooling and cleansing the gas. Adjacent to the coke-oven plant is the coal-washing apparatus, consisting of raw-coal bins, crushers, and washed-coal bins for delivery to the ovens. The capacity of this plant is 2,400 tons a day.

The sulphuric-acid plant is especially complete, and has a capacity of forty tons of acid a day. The equipment, which is thoroughly modern, presents a modification of the old chamber system. In the manufacture of the sulphuric acid, pyrites is used, and of this commodity also an adequate supply is found close at hand, the pyrites mines of Newfoundland being drawn upon. And finally, giving consideration to the last of the essentials for iron-making, it may be noted that even the limestone for use at Sydney is secured with less expenditure for transportation than is possible at almost any other similar plant in the world. The quarry on the Great Bras d'Or lakes is at an elevation of about 300 feet above the level of the lake, and the stone, which is marble of particularly good quality, is lowered to a crusher by means of a skip-car system with a drum at the top, the loaded car hoisting the empty. The crushed stone is fed by gravity to a two-foot conveying belt, by which it is carried to an open bin at the foot of the mountain. The bin is provided with chutes opening upon a three-foot conveying belt, of a capacity of 600 tons an hour, which transfers the crushed stone to an incline belt communicating directly with the loading pier. This also has a capacity of 600 tons an hour, and a vessel is loaded in three or four hours. In addition to this marble quarry the Dominion Company has at St. George's River, only fourteen miles from Sydney, a dolomite quarry with a capacity of 1,200 tons a day.

The steel works proper embrace four blast furnaces, ten 50-ton open-hearth furnaces, a 36-inch blooming mill with pit furnaces, and a large machine shop and foundry. In conjunction with these is a full ore-handling equipment and an industrial railway system, aggregating some twenty miles in length, for facilitating the expeditious transfer of material from one part of the works to another. In the case of a plant of the magnitude of that at Sydney an adequate fresh-water supply is, of course, a most essential requisite, and importance attaches therefore to the fact that the supply obtained from Sydney River, about five miles from the site of the works, is practically unlimited. The drainage of an area of 65 square miles is available, and whereas the requirements of the works seldom, if ever, exceed 3,000,000 gallons a day, there are in the brick pumping station two duplex, direct-connected, triple-expansion condensing pumps, each of which has a capacity of 3,000,000 gallons a day.

For unloading the iron ore from the boats in which it has been transported from Great Bell Island to Sydney, there are four hoisting machines or towers of a type similar to those in use at St. Lawrence River ports for handling coal, each of which has a maximum capacity of 1,500 tons an hour. The machines occupy positions directly above a superstructure, upon which is a double-track system for handling cars. Ore is unloaded directly from the boats to shallow bins or hoppers, from which it is delivered to hopper-bottom cars. The track trestle, previously mentioned, affords communication between the pier and the stock-yard, which is nearly a thousand feet in length and capable of holding a six months' supply of ore and limestone for four blast furnaces. The stockyard is provided with three of the traveling bridge tramway machines, such as are used so extensively in furnace yards in the United States. These machines are independent motor-driven, and each has a span of 225 feet. Over the skip pit at each furnace are storage bins, from which the raw material is fed directly into the skip cars which take it to the furnace.

The stacks of the four blast furnaces are 85 feet in height and 20 feet in diameter. The furnace shell is 28 feet in diameter at the mantle, and the bustle pipe surrounding the columns is 46 feet in diameter. The stoves are of the Cowper type, and have in each instance a casing 21 feet in diameter and 85 feet high. The stove chimneys, which are 9 feet in diameter, are 200 feet high and are provided with heavy cast-iron bases. The engine house contains five pairs of blowing engines, and in the boiler house adjoining is a battery of boilers of 8,000 horse power. Pumps with a capacity of 6,000,000 gallons per twenty-four hours obtain their supply from the harbor. The metal from the blast furnaces is taken in 25-ton ladle cars to a motor-driven, pig-casting machine, which has a daily capacity of 1,600 tons or, if desired, the molten metal may be transferred direct to the open-hearth furnaces.

The open-hearth furnaces, ten in number, are of the tilting type. They are arranged in a continuous row, and metal may be put into the furnace from either side, while cold pig or stock may be fed by means of two charging machines. The product of the furnaces, averaging 1,400 tons a day, is tapped into 50-ton ladles, from which it is poured into molds set on cars, and transferred direct to the stripper building to be deposited in the pit furnaces. The blooming mill has a 35-inch train, and the building is equipped with two 20-ton electric overhead traveling cranes, which may be used for charging or for drawing ingots from pit furnaces. In connection with the open-hearth plant there is a calcining, grinding and mixing plant, of a capacity sufficient to furnish all the linings, refractory material, etc., which may be needed. In considering the possibilities of the Canadian iron and steel industry, it must be remembered that the Dominion government offers bounties on every ton of pig iron or steel produced. At present the bounty is $3 a ton on pig iron made from native ore and the same amount on steel; but the amount of this bounty will be gradually reduced until in 1907 it will be but 60 cents a ton on each of the commodities mentioned.

THE USE OF BALLOONS IN WAR.

By ERIC H. STUART BRUCE, M. A.

THE object which stimulated the practical invention of the balloon was its use in war. I say practical invention, because in theory the balloon dates back as far as the elucidation of the principle of the pressure of fluids by Archimedes of Syracuse. But it was its use in war which fired Montgolfier, the paper-maker of Annonay, in 1773, to fill his paper bags with heated air, and Charles, the Parisian, in the same year, to eclipse the fame of the former by the invention of the gas balloon.

Ten years after the experiments of Montgolfier and Charles, balloons were first used in warfare by the French government for the very same purpose as that for which they have been used in the South African war, viz., for taking observations of the position and movements of the enemy.

It was Guyton de Merveau who first suggested their use to the Committee of Public Safety, and the first experiments were so successful that a regular company was formed, called "Aerostiers," and the School of Ballooning established at Meudon. The picture on the screen represents the operations of the Aerostiers. The first military balloon made was called the "Entreprenant." This was used at the sieges of Maubeuge and Charleroi, also at the battle of Fleurus. On this latter occasion it is recorded that the balloon remained in the air ten consecutive hours, every movement of the enemy being seen and signaled. It was again used at the siege of Mainz. In 1796 the French government manufactured some more war balloons, which were sent to the armies of Düsseldorf and Stuttgardt. Altogether, it would seem that better work with captive observation balloons in war was done at that early period than during the whole time which elapsed between those wars and the South African campaign. This, without a doubt, forms the greatest object-lesson of the use of captive balloons in war on record.

It was Napoleon the Great who disbanded the two balloon companies which had been formed, closed the school at Meudon, and sold the balloon material. Carnot used a captive balloon at the siege of Antwerp in 1814, and another was used in 1859, on the eve of Solferino. In the civil war in America, a regular balloon service was organized, as also in 1866, in the war between Paraguay and Brazil. During the siege of Paris, in 1870-71, the use of free balloons in war was successfully demonstrated, and to this use I will later especially refer. Since that date military balloon establishments have been founded in most European armies and in America. Balloons were used by the French in the Tonkin expedition of 1882, and at Bac-ninh and Hoang-ho in 1884. In the Madagascar expedition, in 1895, a balloon party was taken out, though no actual use appears to have been made of the balloon in that campaign. It is, I think, not generally known that before the present South African campaign the balloon was used in South Africa in 1884, when the late Col. Esdale and Major Trollope made several ascents in the now historic "Mafeking."

There could have been no better opportunity for displaying the value of the balloon as an adjunct of war than the fierce campaign which has been in progress in South Africa. Its use in one position alone, that of Ladysmith, has justified the expenditure that our government has sanctioned in forming what is undoubtedly the first military balloon equipment in the world. To reconnoiter the enemy is the principal use to which balloons are at present applied in the British army. Critics may, perhaps, have wondered why other developments of balloons have not been evolved by our national aeronauts; why, for instance, there have not been experiments with navigable balloons, or rather balloons so far navigable as to combat very light winds, as did Capts. Krebs and Renard, in 1885, with their balloon "La France," or M. Santos-Dumont with his "No. 6," last summer. But we have not far to look for reasons for the omission of the endeavor to extend the balloon service beyond mere reconnoitering. It must be remembered that the balloon section of the British army as it exists to-day is of comparatively modern date, that a few years ago the balloon service in our army was only represented by a balloon committee, who were much handicapped by the slenderness of the grants they received for carrying out their expensive experiments. During the years 1885 and 1886 so much skepticism as to their utility existed that fears were entertained by some as to the ultimate position of the British war balloon. But the power of individuality saved the situation. Fortunately for the balloonists, the Inspector-General of Fortifications at that time was Gen. Sir Andrew Clarke. It was his keen-sightedness that foresaw the day when the country would need her balloon eye. It was his enthusiasm that won for the aerial experiments fairer consideration and ampler funds, until repeated experiments on field-days and in maneuvers gradually dispelled prejudice and skepticism, and secured for the balloons a decisive recognition. When more adequate grants first came to hand it was expedient to expend them on mere necessaries, for instance, to replace the sheds in which the balloons were made and stored at Chatham by the spacious factories and balloon-house now erected at Aldershot. The experts, in concentrating their past efforts on one important and practical branch of military ballooning, and making that as perfect as possible with the means at their disposal, displayed wisdom, though doubtless they will not hesitate to extend their efforts to other branches of ballooning, provided they are amply supplied with the sinews of experiment.

Perhaps the strongest point concerning the national balloon equipment is the material out of which the balloon is constructed, viz., gold-beaters' skin. The adoption of this material was nothing short of a stroke of genius on the part of Col. Templer and the other officers associated with the balloons, and on the fact of its adoption depended the success of the balloons in the South African war. For some time past toy balloons had been made of this material, and sold in abundance by opticians; but to our government belongs the honor of making large balloons, to carry passengers, of this material. A fine photograph of the British goldbeaters' skin balloon is before you on the screen. Next you see the balloon in midair. Balloons made of goldbeaters' skin have the advantage of retaining the gas much longer than balloons made of varnished silk or cambric, for there is no varnish in the market that is so successful in retaining the subtle hydrogen, or near the mark in accomplishing this. There is a tradition on the Continent that, in the early days of ballooning, there was a fairly gas-proof varnish, and that the secret was lost. If so, the chemist may do a real service to aeronautics in re-discovering it. Another advantage of goldbeaters' skin balloons is that they do not easily heat, while the ordinary cambric balloons are notorious for heating or getting sticky. The former can be used with much greater safety in hot climates. In the issue of the Aeronautical Journal for October, 1899, extracts from the official report of Lieut.-Col. J. E. Maxfield, United States Volunteer Signal Corps, to the Chief Signal Officer United States, are quoted, under the title "War Ballooning in Cuba" (p. 83). It is related how the United States Corps, when they wanted to use the old balloon after the landing of troops at Daiquiri, found that the extreme heat had softened the varnish so as to cause the parts of the envelope to stick together, with the result of scorching, which rotted the balloon. This scorching is almost an every-day occurrence with balloons made of varnished silk or cambric if they are packed up without attention. Their manipulation requires the utmost care, which in transport cannot always be afforded. Even during manufacture an ordinary varnished balloon may burst into flame if the weather is fairly hot and the ventilation of the factory insufficient. I have myself seen the partial destruction of a balloon of 100,000 cubic feet capacity in a

few moments during its manufacture on a warm, spring day, in too confined a space. A third but all-important advantage of the goldbeaters' skin balloon is its extreme lightness compared with balloons made of other materials. Here I have a small balloon made of goldbeaters' skin. If this balloon was made of ordinary material, varnished cambric, the gas contained in it would not lift its own weight; make it ten times the size, and it would remain a dead weight; but made of this light material, it rises to the ceiling of the room. Thus the use of goldbeaters' skin secures a much smaller-sized balloon for a given lifting power than does varnished cambric or silk. In reference to the report above quoted, Lieut.-Col. Maxfield came to the conclusion that balloons employed in military reconnaissance should be at the least 18,000 cubic feet capacity; but our British war balloon can be only of 10,000 cubic feet capacity, and thoroughly efficient. The reduction in the size of the balloon by the use of goldbeaters' skin does not only reduce the size of the balloon, but also the weight of the balloon equipment, when cylinders of compressed gas are taken out to the field of operation, for filling the balloons. According to figures quoted by Lieut. Jones, in a lecture he delivered at the Royal United Service Institution, the balloon of 10,000 cubic feet capacity would require only about 84 steel tubes to fill it, each of these being about 8 feet long, and 5¾ inches in diameter, containing 120 cubic feet of gas, and weighing 70 pounds. If, on the other hand, a balloon of 18,000 cubic feet is used, as is officially recommended in the United States, the number of tubes required would not be far short of double the number.

A fourth advantage of the goldbeaters' skin balloon is strength. At first sight the material may seem too fragile, for most persons are familiar with goldbeaters' skin as the thin, transparent plaster which is used for a cut finger. But the desideratum of strength is obtained by combining layers on layers of the substance to any desired thickness.

The system adopted by our government of compressing the gas in steel cylinders, and taking them to the place of operation, is undoubtedly handier than filling the balloons direct from the manufacturing apparatus, and by the cylinder method it can be done with far greater speed. To show how easily and quickly a balloon can be inflated from a cylinder, I will fill this small balloon before you.

As regards the actual operations with the balloons in the South African campaign, speaking as a civilian in the presence of military experts, I wish it to be distinctly understood that I speak under correction. To the best of my powers, I will put forward a few instances when I believe the British war balloon was of inestimable value. Before making these remarks, I will show you an excellent photograph of a balloon convoy crossing a river in South Africa, taken by S. W. Maxwell, of the Standard.

It was the Second Balloon Section that went to Ladysmith, and got up just in front of the sailors. The balloon observations were carried out at Ladysmith as long as the balloon and gas lasted, which was about 27 days. It has been said that our naval guns saved Ladysmith, but it must be remembered that they owed much of their success to the observer in the captive balloon. From his elevated position he could locate the Boer guns, and direct the operations of the British artillery with an unerring precision. A little to the right, or a little to the left, was often the message telephoned down to earth, and that little made all the difference in the accuracy of the artillery fire.

The presence of the balloon withdrew all the Boer fire on to the aerial target, so difficult to hit. Several balloons were, however, absolutely destroyed by shell fire. Once, I am told, a balloon was burst at Ladysmith when at a great height, and had a very quick run down. Regarding the question of the chances of a balloon being struck by the enemy, practical experiments at Lydd showed that a balloon may be almost riddled with bullets in its lower portion and remain in the air, owing to the upward pressure of the hydrogen gas. Some of the balloons at Aldershot that were returned from the war, show signs of the bullet perforation.

Here I have a small captive balloon. I perforate it over and over again in its lower portion. These holes correspond to so many bullet-shots in it, yet it does not fall, but remains in the air. Artillery fire is more formidable; but it is not very easy to hit a balloon when at all high up, as it is difficult to establish the distance between the balloon and the gun, as well as not easy to obtain the required elevation of the pieces. In experiments at Lydd a 13-pounder field-gun was turned on to the balloon when it was 1,000 feet high at a range of 400 yards, and the balloon was not struck till the seventeenth shot. At Ladysmith, it is true, the Boers had the advantage of having the gun they usually used against the balloon posted on Umbulwana, a hill nearly 1,000 feet high, but all the same I am informed that they had a habit of firing on the balloon almost exclusively when it was at a short distance from the ground, some twenty to sixty yards elevation, on its ascent and descent. It was then more easy to get the range.

Capt. Philip's balloon section also accomplished magnificent work with Gen. Buller at Colenso, and up the Tugela River. At Spion Kop, it discovered that our army was going to march into a death trap. On reflecting on the narrow escape of a great disaster averted by the balloons at Spion Kop, the thought forces itself upon the mind, What would have happened had it not been for that happy aerial observation at that critical moment? What might have been the effect of depression on our army, and exhilaration on the part of the Boers? I will not go so far as to hint that Ladysmith might have fallen, for the history of the sieges of Ladysmith and Mafeking show how difficult it is to find the limit of British endurance. But I will say that this brilliant achievement of the balloonists facilitated the relief of the hard-pressed garrison; Capt. Jones' section went up with Lord Methuen on Modder River and the observations continued every day. In the opinion of experts there was not a single day that they were not absolutely of the highest importance. Lord Kitchener also used balloons, and it is stated that through information obtained by them the British army was enabled to march on to Pardeburg. At Pretoria too the balloon rendered the greatest service. It located the whole position and no chance was given for the enemy to escape. On this occasion the balloon worked for five days continuously and was shot in several places. Major Blake's section went to Mafeking, and there one of the most brilliant balloon exploits of the campaign was accomplished at Fourteen Streams. By the balloon observations taken at that point the Boers were prevented from relieving Fourteen Streams. In this case the balloon was worked for thirteen days continuously with one inflation. This was the best possible test of the efficiency of the retentive power of the goldbeaters' skin balloons. Much is said at the present moment about the backwardness of the British nation in aeronautical matters. In answer to such statements, I would express my opinion, that at the present moment, no other nation in the world could have produced a balloon of the same size, that could have thus worked for thirteen days with one load of gas. I am able to show you, by the kindness of Messrs. Underwood and Underwood, two very good photographs of the British war balloon at the front. The first shows Lord Roberts' army marching toward Johannesburg, the 84th battery and balloon corps, the second the balloon ready to ascend for observation with Lord Roberts' army advancing on Pretoria.

The nature of the climate and country in South Africa afforded some conditions that were favorable to the working of the balloon, others that were unfavorable. A favorable condition was the translucency of the atmosphere. A correspondent in the Graphic pointed out that the translucent South African atmosphere peculiarly lent itself to balloon observations; that in maneuvers in England the range of a balloon's effective vision at a height of 1,000 feet is not more than seven or eight miles, whereas in South Africa it is ten or twelve miles. A disadvantage of the climate would appear to be the strong winds that blow frequently and often in gusts. Wind is the bugbear of the captive balloon, and limits its general use. I may mention that as an attempt to increase the number of days upon which a balloon may be worked, the Germans invented the drachen or kite balloon, which is supposed to resist strong winds. The balloon is cylindrical, with hemispherical ends, and is attached to its cable like a kite, so that the wind acts to lift and not depress it. The cylinder is divided by a diaphragm near its lower end into two chambers, the upper and larger one being filled with gas, while the lower chamber by means of a valve opening inward receives the pressure of the wind which presses against the diaphragm and preserves the sausage-like form of the balloon in spite of leakage of gas. Another windbag incircling the bottom of the air-chamber serves as a rudder, and latent fins or wings give stability to the balloon about its longer axis. It would, however, be necessary that a series of comparative experiments should be carried out on the same days with spherical and sausage-shaped balloons before forming a definite opinion as to the advantage of the latter. At any rate the military experts in this country have not thought it advisable to discard the spherical balloon.

In South Africa, besides ordinary windy weather, there are frequent whirlwinds, or, as they are called, "devils." It appears that more than once the balloons were caught by these. A somewhat disadvantageous circumstance was the heights that had to be traversed. On the march to Pretoria there were hills 6,000 feet above the sea level. To make an observation on these hills the balloon had to ascend to some 2,000 feet, making the barometrical height 8,000 feet. This was a strain on the buoyancy of the balloons, and, in fact, they worked very near their possible limit.

Throughout the campaign the Boers absolutely dreaded the far-seeing eye of the balloon so opposed to their system of warfare. One of their prisoners is reported to have said, "If ever we catch the man in the balloon we'll make mincemeat of him. He is the one which does us the most harm. We could not move, we could not creep from one stone to another but he pointed us out, and we'll pay him out for it if we lay hands on him." I may mention, what I believe is not generally known, that the Boers had an offer from a foreign country, to be supplied with war balloons, but they refused the offer, saying that they would not know how to manage them if they had them. I should mention, that during the critical period of the war, the whole strain of supplying the balloons to the seat of war fell upon Major F. C. Trollope, who was in superintendence of the balloon factory at Aldershot. One of the greatest testimonies of the skill and resourcefulness of this officer was, that though the crisis in China came in the middle of the exigencies of the South African campaign, and necessitated a supply of balloons for that country also, he was still able to send a show balloon section to the Jubilee in Australia.

There is a use for the captive balloon in war besides observation, viz., for signaling. It has been my privilege to invent a system of balloon signaling, and to supply the apparatus to the British, Belgian, and Italian governments, and I feel that it will be legitimate for me to say a few words upon this system, for the reason that, as far as this invention is concerned, commercial considerations have not been my direct aim. If the results of my experiments prove of use to the British Army in an emergency, that will be my reward.

The advantage of signaling from a balloon is the altitude obtainable. Any system of signaling can be used from the car of an ordinary captive balloon, such as flag or lantern signaling; but signaling from the car of a balloon necessitates the use of a balloon of not less than 10,000 cubic feet capacity, and a balloon of such a size entails the bulky transport of cylinders of compressed hydrogen gas. This fact limits the practicability of signaling from an ordinary balloon.

Some few years ago it occurred to me to apply electric flash signaling to a captive balloon so that the operator and most of the apparatus may remain on the ground. In this system, since the weight of the car and operator is abolished, the balloon can be of such a size as to be portable, quickly inflated, and easily manipulated. The details of this system are well known. In the interior of the balloon made of translucent material are placed several incandescent electric lamps. These are in metallic contact with a source of electricity on the ground. In the circuit on the ground is an apparatus for making and breaking contact rapidly. By varying the duration of the flashes of light in the balloon it is possible to signal according to the Morse or any other known code. Here I have a model signaling balloon in mid-air. I depress my signaling key, and the balloon appears like a globe of fire. By varying the duration of this globe of fire, by long or short depressions of my key, I can signal a sentence according to the Morse or any code. On the switchboard which contains the signaling key there is an arrangement by which the lights can be continuously switched on thus. The continuous illumination has its uses in war. It can be used as a preconcerted signal, or as a point light to concentrate troops at night to a given place.

The picture now on the screen represents the signalers of two friendly military forces shut in by high mountains. It shows how limited is the usefulness of ordinary visual signaling which depends upon some vantage point for altitude. It shows, I think, how valuable in such a case is the electric signaling balloon. I will ask whether this picture does not fairly represent the conditions realized sometimes in the South African campaign when failure of means of communication was the cause of disaster. Certain examples of the want of means of communication in the war emphasized in my mind the necessity of extreme mobility for the appliances of a signaling balloon so that the apparatus might be conveyed, if possible, by a few men. To meet this need I designed the emergency signaling balloon. Compared with an ordinary balloon transport, I have always described my ordinary electric signaling balloons as portable. Before you is a picture of a signaling balloon of 18 feet diameter taken at the Cork military tournament. This has a gas capacity of 3,000 cubic feet, and it requires 30 tubes of compressed hydrogen to fill it. But the emergency balloon is so portable that it can go wherever the signalers can go, and yet will supply the means of obtaining a considerable altitude for the signals. To accomplish this I have approached the impossible as far as I have dared, and in some parts of the apparatus strength and durability have had to be sacrificed to lightness. However, if a whole battalion could be saved by the use of an emergency balloon this sacrifice would be justified, even if the balloon could only be used for a few times. This, however, would not be the case, as the balloon could be used a number of times. To obtain lightness in the emergency balloon I employ goldbeaters' skin instead of varnished cambric, with the material of which only larger signaling balloons were made. Then the metal aluminium, the density of which is only 20.6, helps us to obtain portability, for we can make the ladder frame on which our lamps are suspended of this material. Mobility is also afforded by improvements in electric storage batteries, which are thereby rendered very portable. These two small batteries contain six cells in each, and I will just show you how brilliant a light it is possible to get with the two batteries, which can be carried one in each hand. Such a battery as this would supply power for intermittent signaling for weeks. In such cases, where batteries are not available, I should propose the use of a portable hand dynamo. From this table dynamo I can produce an electric light, and a little exaggeration of this would provide us with power. I reckon that the smallest possible size for an emergency electric signaling balloon to be useful, would be seven feet diameter. This would lift a light cable, and the lamps a few hundred feet, and only require gas cylinders 120 cubic feet capacity for its inflation. There would therefore be no difficulty about its transport. A better size, giving more useful lifting power, would be eight feet diameter; I consider that the emergency signaling balloon might be even ten feet diameter, without the transport being impracticable in places inaccessible to wagons.

It has sometimes been urged that the signaling balloon is only of use in absolutely calm weather. The view upon the screen contradicts this statement. It illustrates the use of the electric signaling balloon in half a gale of wind, on the evening I carried out the experiments at the Stamford Bridge Grounds, in the presence of H. S. H. Prince Edward of Saxe Weimar and a number of military and naval experts of various nationalities. This I accomplished by the liberal use of guy ropes. Some of the government trials of my signaling balloons have taken place in very unfavorable weather conditions, for instance, on the occasion of the trial of the balloon in connection with the signaling department at Aldershot, in January, 1885, there was a snowstorm and a mist. A party of signalers was stationed three miles from the camp, and in spite of the mist and thickly falling snow, the signals were read and answered. This was a remarkable test, because the balloon on its descent was found to be crystallized, and much of the light must have been obscured, first by the falling snow, and second, by the crystalline coating on the balloon.

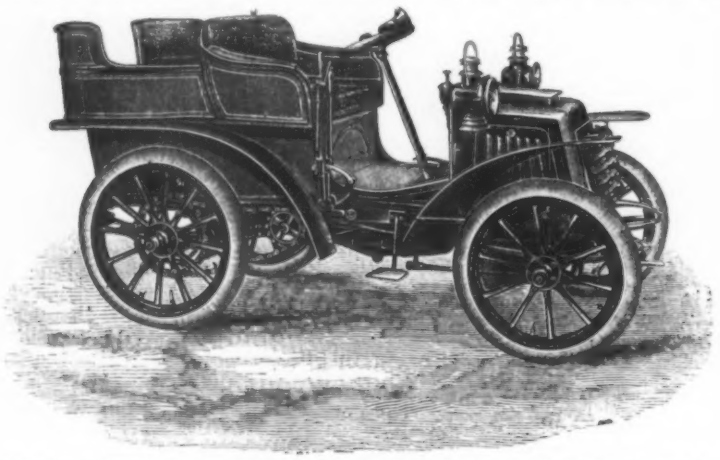
There are some details of the system on the lecture table which may be of interest. Here is the ladder-shaped holder of lamps which is placed in the larger size signaling balloon. This is the lighter aluminium frame for use in the emergency balloon. This is the signaling key I first made with platinum rubbing contacts, and this the later form of key with removable carbon contacts for use with heavy currents. Here we have the arrangement for suspending the lamps outside the balloon, a plan I adopted in foggy weather. This is the special holder of lamps placed inside the great electric balloon of 100,000 cubic feet capacity which I made some years ago for the Crystal Palace Company.

The free balloon has its use in war, as well as the captive one. At the time of the siege of Paris, this was demonstrated most efficiently. At the time when the Parisians found themselves cut off from all ordinary means of communication, there were only a few balloons in Paris, but the successful escape of some aeronauts in them was encouraging enough to establish an aerial highway involving a more wholesale

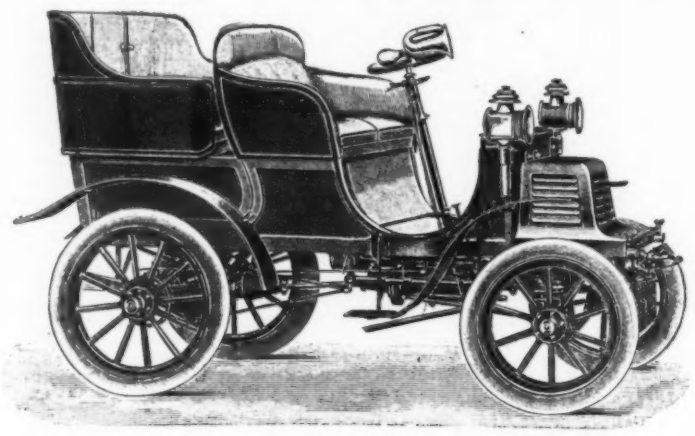
manufacture of balloons than has been accomplished before or since that period; the disused railway stations were converted into balloon manufactories and training schools for aeronauts. During four months 66 balloons left Paris, 54 being specially adapted for the administration of post and telegraph, 160 persons were carried over the Prussian lines, 3,000,000 letters reached their destination, 360 pigeons were taken up, of which only 57 came back. These, however, brought back 100,000 messages.

The utility of a free balloon in war would, however, be largely increased if it could be steered against a wind of considerable power. Aerial warfare in navigable balloons is the prophecy of the poet. Tennyson has written of "the nations' airy navies grappling in the central blue." But science as yet has not produced a navigable balloon capable of fulfilling this vision of fancy, and even if it had it is probable that an international convention would prohibit the discharge of explosives from aerial vessels, "the rain of ghastly dew," as being too barbarous even for modern warfare. Though I do not wish to speak in defense of such a system of warfare, yet I would ask whether torpedo warfare, which is generally accepted, is not equally uncivilized? But if never used as a floating battery, a balloon that could navigate the air against even a moderate breeze would be a great advantage to an army for scouting purposes. Briefly let me describe the principal attempts to produce a navigable balloon, and show you some illustrations of the various types. Giffard, in 1852, was the first to make a navigable balloon of elongated form in which the motive power was steam, a very light engine and boiler working a screw 12 feet in diameter, as shown in the picture. He ascended in this balloon on September 12, 1852, on a very windy day and did not attempt to struggle against the wind. In 1883 the brothers Tissandier constructed an elongated balloon, the screw of which was worked by an electric motor, and claimed that they held their own against a wind of three meters a second. In 1885 Capts. Krebs and Renard experimented with their fish-shaped balloon "La France," in which the motive power was also electricity, and with this balloon they made five return journeys out of seven ascents, and combated a wind force of from 3 to 3½ meters per second. In 1889 Count Zeppelin built his vast airship, composed of 17 separate balloons, held together by an aluminium framework. A snapshot of this balloon in midair is shown you. In this the motive power was provided by two Daimler motors of 16 horse power working four small screws of 44 inches diameter. But this airship, probably for the very reason of the smallness of its screws, did not excel the performance of Capts. Krebs and Renard in 1885. In 1901 M. Santos-Dumont made his famous voyage round the Eiffel Tower with his No. 6 navigable balloon, the screw of which was worked with a 20 horse power petroleum engine. When we examine the wind forces overcome, in the Santos-Dumont's experiments, we find they amounted to about 4½ to 5 meters per second, an advance of a meter and a half per second on the experiments of Capts. Krebs and Renard in 1885. But it must be remembered that the latter had only 9 horse power, whereas the former had 20 horse power.

With present knowledge, a balloon can be steered in calm weather, but the question how to navigate it in any wind is absolutely unsolved. This working model shows you the principle of a navigable balloon. In the calm air of this room, by means of its rudder and screw, we can navigate it where we will. To further the solution of the problem of a navigable balloon, capable of being useful in war, careful quantitative experiments will be more useful than any number of the more sensational journeys under the conditions of money prizes in which the scientific desiderata are not sufficiently taken into account. When I say this I do not belittle the work of such heroes of aerial navigation as M. Santos-Dumont. By his bravery and perseverance he has winged the petroleum motor, and shown possibilities for the future. But in the future the problem must be more seriously attacked than for the purposes of sport. The time has arrived for the endowment of aeronautical research. In conclusion, may I express the hope that before long the British nation will apply to aeronautics some of its engineering skill, and launch into the air a navigable balloon which will be able to overcome a sufficiently strong wind to add to the resources of our national defenses.



LIGHT AUTO WITH FOUR SEATS. PANHARD & LEVASSOR, PARIS.

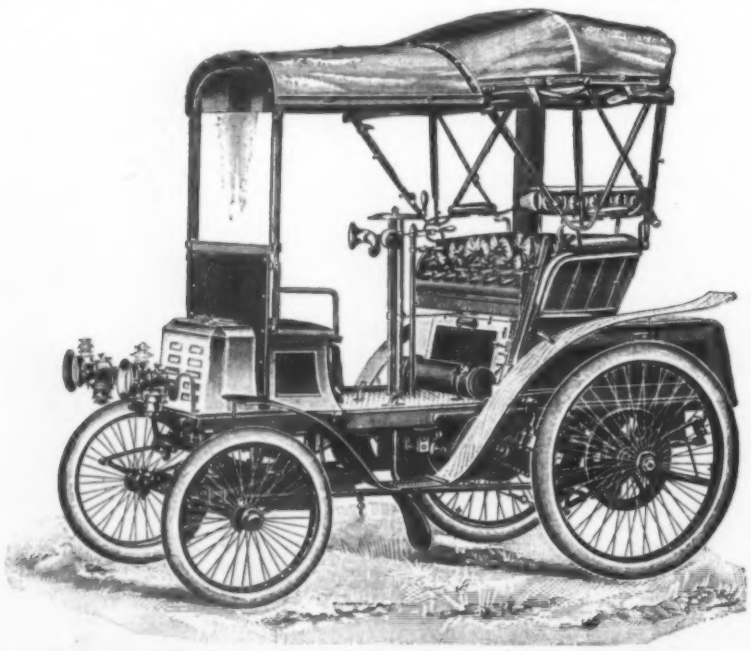


ADLER AUTO NO. 3 A (TONNEAU) FOR FOUR PERSONS.

THE LEIPSIC AUTOMOBILE SHOW.

THE recent exhibition of automobiles, etc., in the "Krystallpalast," at Leipsic, may be considered as the most complete of its kind, notable not only for the number, but also for the great variety of the types on exhibition. The number of types has increased, because well-known firms, such as De Dietrich & Co., Panhard & Levassor, Benz & Co., Cudell & Co., etc., have replaced their original models by new ones, and at the same time many new firms have sprung up, some of whom are already represented by excellent constructions. In the running gear of the firm of W. Schoenst, of Kassel, and also that of Dr. Klingenberg, the customary change speed gearing, now serving as a reserve, is replaced by expansible disks, after the American pattern, whereby the entire starting mechanism is simplified in a manner not heretofore considered possible. A general tendency to simplify the construction is perceptible, not only in the case of the above-named motor, but with most of the types exhibited. The aim for greater simplicity of the running gear, as well as of the motor and the starting mechanism, may be considered the characteristic feature of the exhibition. This is especially apparent in the motocycles, which actually show a remarkable progress compared with former types. The "Cyclon" motocycle of the Maschinenfabrik of Franz Huettl, of Erlau, has a small motor, fitted with two little flywheels, on the fork of the front wheel, handy for the operator. At the same time this arrangement allows the omission of the cooling apparatus, for the strong draft caused in riding is sufficient to cool the cylinder. This kind of installation naturally reduces the weight of the motor; it varies from 32 to 35 kilogrammes. The above-named motocycle differs from that of the firm of Laurin & Klement, of Jungbunzlau, in that the motor of the latter is fastened in the frame between the wheels, a construction which is still followed by most of the motocycle makers.

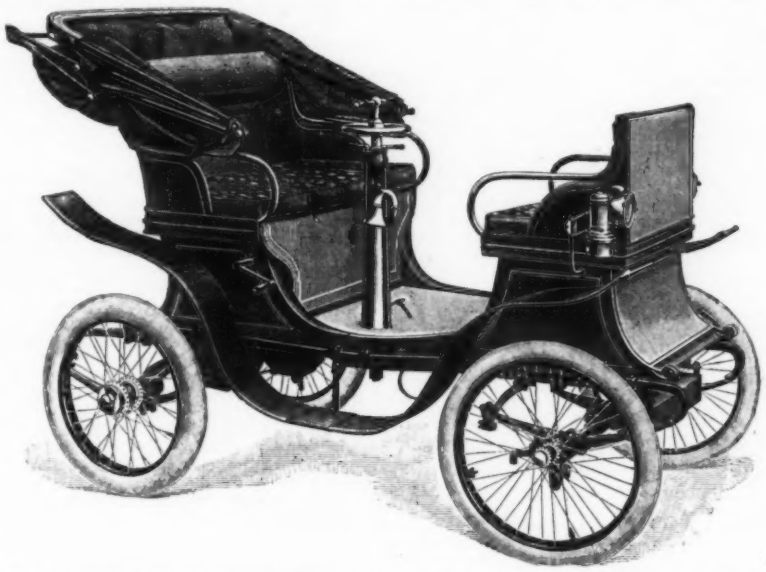
As regards types of different autos, almost all systems from the elegant bridal carriage to the beer wagon and truck of the heaviest construction were represented. There are the automobiles of the Bielefelder Maschinenfabrik, formerly Duerkopp & Co., which are fitted with one, two and four-cylinder motors of four-cycle type, the cylinders being screwed singly upon an oil and air-tight casing. The inlet valves work automatically, while the exhaust valves are actuated by cams. All the larger motors have centrifugal governors. The number of revolutions varies from 800 to 1,000 per minute, but can, if necessary, be increased to 1,500. The ignition is accomplished by an electric spark, the cooling is by water, which is recooled in a coil with ribs. A small pressure pump sucks the water from a reservoir and leads it to the parts to be cooled, from which it will return into the recooling apparatus, and from there again to the reservoir. The steering, even in the case of beer wagons, is performed from the driver's seat, and the vehicle can be run at three or four different speeds. Besides, a reversing contrivance is present, which renders it possible to back up the auto in the customary way. The gear is such that speeds up to 60 kilometers can be attained, if desired. The Allgemeine Automobilgesellschaft, of Berlin, is represented by a "tonneau," system Dr. Klingenberg, for four persons. The motor, which is covered by a casing, as well as the auto itself, gives the impression of elegance and careful construction. Steering is performed in the same manner as for the Duerkopp auto—from the seat of the driver. Particularly prominent is the exhibit of the firm of De Dietrich & Co., of Niederbronn, which among other objects, shows an omnibus for six or more persons. The body of this omnibus exhibits more or less the same design as that of the well-known variety drawn by horses, and as regards motor and running gear the usual style of the firm is adhered to. As a special object this firm has placed on exhibition the victor in the race between Leipsic and Wurzen. We may next name the firm of Benz & Co., of Mannheim, represented by their patented automobile, named "Ideal," for three persons. This carriage is driven by a benzine motor of 3 to 4 horse power,



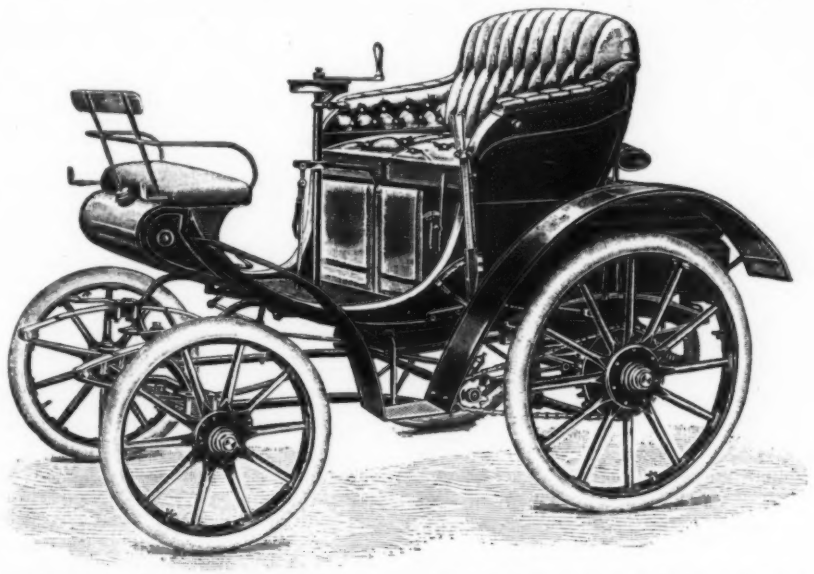
NEW PATENT AUTO "IDEAL" OF BENZ & CO

TONNEAU AUTO FOR FOUR TO SIX PERSONS, WITH COUPÉ ATTACHMENT. HUGO MAYER & CO.

the power being transmitted by belts to a countershaft with differential gearing, and from there by chains to the back wheels. A worm with pumps effects the cooling of the cylinder, while steering is performed by a patented contrivance of precise action in the customary manner. A very elegant auto with four seats, tonneau shape, is shown by the Compagnie Belge de Vélocipèdes, of Liege; the same is also characteristic in that the lower and upper frames can be completely taken apart. The motor is, of course, firmly



PHAETON OF THE ACTIENGESELLSCHAFT FUER MOTOR UND MOTORFAHRZEUG-BAU.



OPEL MOTOR-CARRIAGE (NEW TYPE), FOR THREE OR FOUR PERSONS, DRIVEN BY INCASED BENZINE MOTOR.

and easy manipulation. Benzine with a specific gravity of 0.7 is used, one filling of the tank being sufficient for traveling a distance of 100 to 120 kilometers with a velocity up to 35 kilometers per hour. The brake is so powerful that by the simple movement of a lever the auto can be stopped almost instantly, even when going at the greatest speed.

Of special interest are the exhibits of the Magdeburger Motorwerke; they show the advancement in the construction of the body of the carriages, demonstrating that automobiles can be employed for all purposes for which only the horse-drawn carriage was considered suitable. The same firm shows, with other vehicles, a bridal carriage elegantly furnished with lace curtains, flowers, etc., which greatly attracts the attention of the lady visitors. One of the most interesting features of the exposition is an auto by the same firm which may be used as an elegant turnout on Sundays and as a baggage wagon on week days. By the simple exchange of the upper part for another, the transformation is accomplished in the shortest possible time. In its endeavors to simplify the automobile, this firm also demonstrates that it is no longer necessary to creep under the carriage to perform repairs or make inspections; they have constructed the superstructure in such a manner that the latter may be readily lifted off.

A 4½ horse power motor is employed, with cooling by water and circulation pump, as well as ignition by rubbing contact. They claim the consumption of benzine to be 12 liters per 100 kilometers, and the auto is said to take up-grades of 16 per cent without trouble. It is scarcely necessary to state that the wheels run on ball bearings and that the hubs are strong. Owing to the great number of revolutions of the motor (2,000 per minute), a direct transmission of the motion to the axle was, however, not possible, it being necessary to diminish the number of revolutions by change-gears. Another example, of a tonneau with coupé, which is meeting with much favor of late, is that turned out by Hugo Mayer & Co., of Berlin, holding four to six persons.

One of the most extensive exhibitors is the firm of Panhard & Levassor, of Paris, whose light, four-seated auto attracted much attention by reason of its peculiar shape. The motor is called "Centaure," and has four cylinders, working with four-cycle action; the ignition is electro-magnetic. Cooling is effected by water; the propulsion of the carriage is by chains installed in the lower frame and transmits its motion to the driving wheels, which are of the usual spoke pattern. It is a four-phase benzine motor, with electric ignition and cooling by water and makes 600 to 1,600 revolutions per minute. The carbureter employed works on the spray system.

The Adler motor carriage No. 3a may likewise be regarded as characteristic of its purpose. The vehicle contains seats for four persons, a 4½ horse power motor, with cooling device by water, and is arranged for three speeds of 6½, 14 and 27 kilometers, as well as for running backward at a speed of 4.5 kilometers. The motor is attached in the front part of the auto and is accessible from all sides. The water is recooled by ribbed copper pipes, a slow-acting geared pump with hard nickel-toothed wheels keeping up the circulation of the water. Electric ignition is employed, the transmission of power from the motor being by friction clutches and axle; the belts and chains usually employed are omitted. The rear-wheel axle is fitted with the double driving mechanism, transmitting equal power to both wheels. On the inside of the rear wheels are powerful friction band brakes, which, actuated by a handle, can bring the auto to a sudden standstill on any ground. A third strong band brake for foot power acts directly upon the transmission mechanism beneath.

Worthy of mention are the light alcohol autos of the firm of Fritz Scheibler, of Aix la Chapelle. They are fitted with 3 to 4 horse power motors and have the appearance of the greatest ease. The upright motor is installed in the front frame of the auto; the stroke is 110 millimeters and the bore likewise 110 millimeters; number of revolutions, 600 to 900 per minute. Instead of by a special cooling apparatus, the cooling is attained by the draft caused by the speed of the auto. The inlet and exhaust valves are so arranged that they can be inspected at any time. Ignition is electric, the carbureter being of such construction as to be available for either alcohol or benzine. The transmission of power from the motor to the running gear is by belts, the arrangement of the belts, tightening automatically according to the power required, being especially noteworthy. The use of alcohol in preference to benzine or petroleum is commendable by reason of its odorlessness, since it has been determined that its cost is not greater.

The products of the Actiengesellschaft fuer Motor und Motorfahrzeug-Bau, formerly Cudell & Co., of Aix la Chapelle, are about as well known as any on the market. The manufacturers show among others a phaeton, in which the benzine motor, system De Dion-Bouton, peculiar to all the Cudell autos, has been employed for the generation of power.

Very interesting showpieces are the traveling and sporting autos of the Nuremberg Motorfahrzeug Fabrik "Union," also the Opel automobile (new type) for three to four persons, constructed by the firm of Adam Opel, of Ruedesheim-o-M.

For our engravings and the accompanying description we are indebted to Illustrirte Zeitung.

THE PROBLEM OF ALCOHOL FOR MOTIVE POWER.

A CONSIDERABLE amount of attention has been excited on the Continent, particularly in France during the last year or year and a half, by the question of the applicability of alcohol to the operation of explosion engines. The reasons for this are of course mainly economic. The movement for utilizing alcohol for motor purposes was originally suggested by the large amount of that substance manufactured in the country and by the extensive facilities which the large number of beet-root sugar factories in existence provide for increasing the output, should that become desirable, to a practically indefinite extent. The duty on spirits for commercial purposes in France is high, though in spite of that fact the so-called denatured spirits are obtainable for 1s. 7d. per gallon, a price which it is expected will be reduced by threepence during the current year. That the price is so low as this, in spite of the high duty, inconvenience and expense of denaturation, is a proof of the capacity of the country for producing alcohol, and the Administration conse-

OMNIBUS FOR SIX OR MORE PERSONS OF DE DIETRICH & CO.

quently has in its hands a means of providing the automobile industry with a fuel, the price of which, by diminishing the duty, it can lower to almost any extent. The prospects of obtaining cheap alcohol would appear to be even more favorable still in Germany. Of course a duty upon potable spirits is such a ready and elastic source of revenue, and its maintenance is so strongly supported for quasi-moral reasons by so large a section of every modern community, that there is little prospect of pure alcohol being ever commercially available as fuel. There is all the more reason therefore that denatured alcohol, that is to say, alcohol rendered unsuitable for human consumption, should be freed from duty altogether, while if some more rational and less complicated method of denaturation were adopted, it should be possible to supply it as fuel at a very moderate cost indeed. The heavy benzine employed for the purpose in France renders the alcohol distinctly less suitable for use in explosion motors than it would be without such admixture. On the other hand, the addition of light benzine or petrol has no such effect. In fact, it increases its value as fuel, and would probably render it quite undrinkable. It would seem, therefore, to be a suggestion worth consideration whether the government of France and other countries would not do well to practically abrogate the duty on alcohol mixed with petrol for motor car purposes. By so doing, both the automobile industry and home agriculture would in all probability be mutually and largely benefited. The question of the behavior of alcohol in explosion motors and of the extent to which the alcohol motor may ultimately prove itself capable of replacing the petrol motor, are consequently both of scientific and economic interest, though as it is more difficult to procure legislation calculated to benefit any growing industry in this country, the discussion may be regarded to a certain extent as academic as far as the United Kingdom is concerned.

The extensive series of trials conducted toward the end of last year, under the auspices of the French Ministry of Agriculture, have provided a quantity of figures and data. They have shown conclusively that alcohol can be satisfactorily and economically employed both for operating stationary engines and for running motor cars. The performances of the motor cars driven with alcohol were in general very satisfactory, and the consumption, though in this respect some of the competing vehicles differed rather inexplicably from one another, was by no means excessive. Unfortunately, in the case of the motor vehicles, no data of the motors employed are given, and in order to attempt anything like a scientific analysis of the figures provided by the tests, we are compelled to restrict ourselves to those conducted with the stationary engines, in which at any rate the stroke of the pistons, and the bore of the cylinders, as also the number of revolutions per minute, are recorded. The results are anomalous almost without exception, but there is hardly more variation among them than in the relative stroke of the motors. Confining ourselves to the single cylinder 2 to 10 horse power motors, we find that the stroke varies from 120 mm. with a bore of 100 mm. as a minimum to 360 mm. with a bore of 180 mm. as a maximum. In general the figures seem to show that the consumption of alcohol, whether of the 50 per cent mixture (i. e., 50 per cent pure alcohol and 50 per cent benzine) or pure alcohol only is inversely proportional to the relative length of stroke; thus the highest consumption but one was recorded against an engine with 120 mm. stroke and 100 mm. bore, while the lowest consumption was recorded in favor of the longer stroke Pruvost engine with a stroke of 360 mm. We cannot, however, generalize absolutely quite in this way, for though this conclusion is borne out by the Otto and Merlin engines with the tolerably long stroke of 240 mm., the Japy engine showed a very satisfactory performance with the comparatively short stroke of 160 mm. Nor is the anomaly altogether explained by variations between bore and stroke. Unfortunately the published figures do not supply any data concerning the compressions employed in the different motors. This, as we shall endeavor to make apparent, is a point of supreme importance in the case of the alcohol motor. It is a matter of high importance as regards efficiency in the case of the petrol motor, but it would appear to be of even greater significance where alcohol is employed as the fuel. We publish elsewhere in our present issue the results of a highly important series of experiments with an alcohol motor by Herr Ernst Neuberg, which were carried out recently in the laboratory of the Technical High School of Berlin. Herr Neuberg experimented with pure alcohol (alcohol 92.5 per cent, water 7.5 per cent) and with alcohol mixed with different amounts of benzol and benzine (by benzine being meant the petroleum essence with which we are more familiar as petrol). He also added varying amounts of water up to as much as 39.4 per cent, mixed with the alcohol. The compression employed by Herr Neuberg was a high one, viz., 6½ atmospheres, and he found as a consequence that the amount of petrol (benzine) or benzol which he was enabled to add to the charge was limited owing to the fact that at this high compression premature ignition took place when more than a certain proportion of petrol was used. From what we know of the effects of high compression, and from the fact that with pure alcohol Herr Neuberg obtained the remarkable efficiency of upward of 23 per cent of thermic energy converted into actual work, it is clear that the most efficient compression for use with alcohol is considerably higher than can be used economically with petrol. This fact alone would partly explain what is at first sight rather remarkable in the French tests, viz., that the consumption of alcohol per horse power hour comes out considerably lower than its lower thermal value as fuel would lead us to expect. Inspection of Herr Neuberg's results discloses the fact that as the amount of water contained in the alcohol was increased, the amount of heat carried off by the cooling water from the cylinder walls was proportionately decreased. This, of course, means to say that some of the heat of combustion that would under other circumstances, that is to say, when less water was present inside the cylinder, be wasted in merely heating the cylinder walls, is in that case usefully employed in expanding water vapor, and thereby contributes mechanical energy to the cycle. In addition, the presence of the water tends to prevent premature ignition, and thereby enables a higher degree of compression to be utilized than would otherwise be the case. This, as is well known in the case of all explosion engines, means increased efficiency.

It will be remembered that at the commencement of the current year and the end of last year, we published various articles dealing with experiments that had been made on the Continent with the oil motor of Prof. Banki, of Budapest (Automobile Journal, November and December, 1900, and January, 1901). The leading feature of Prof. Banki's engine, which was a high compression engine, with tube ignition, running on petrol, was that water spray was injected into the working cylinder together with the petrol spray on each intake stroke. The results of this process, it will be remembered by our readers, were in many respects remarkable. The fuel consumption was reduced by approximately one-half. Prof. Meyer, of Göttingen, who published in the Zeitschrift des Vereins Deutscher Ingenieure, a lengthy account of his experiments with the Banki engine, a translation of which we gave at the time, attributed the economy of fuel resulting from the injection of water to two different but confluent causes. One of these, on which we laid considerable stress at the time, was the influence of water in preventing premature ignition, and thereby enabling a higher degree of compression and its resulting economy to be employed than would otherwise have been possible. The other cause was the presence in the working cylinder of a vapor of an expansive nature, which, while like the cooling water it absorbed heat from the heated gases, did so not wastefully but economically, contributing it in fact as mechanical energy to the cycle, through pushing forward the piston by its expanding action. An examination of the results of the French Ministerial tests collated with the results of Herr Meyer's experiments, and brought into comparison with the experiments carried out by Prof. Meyer with Banki's engine, lead consequently to the conclusion, first, that the alcohol motor presents strong analogies with the Banki motor using a combination of petrol and water sprays; secondly, that to obtain the highest efficiency with the alcohol motor, both the stroke and the compression of the motor must be increased. The compression must be increased in order that the advantage which the composition of the fuel in permitting us to use high compression allows us to obtain, may be taken advantage of to the full, and also in order that the presence of water, which is always commercially associated with alcohol, may be converted from a prejudicial admixture which it would be with low compression to a beneficial admixture which it becomes with high compression. The stroke should be lengthened because with the presence of water vapor, acting both as a cooler and a converter of heat into mechanical energy, the best results should be obtained by expanding out as far as possible. This all practically means that motors must be designed for use with alcohol, and that as Herr Neuberg very clearly points out, the most satisfactory results cannot be obtained when using alcohol in motors designed for petrol. Of course, where a mixture of petrol and alcohol is employed a compromise is necessary, that is to say, a suitable motor would apparently be one with a longer stroke and higher compression than would naturally be selected for petrol only, but with a shorter stroke and a lower compression than would give the best results with pure alcohol containing an admixture of water only. We are, therefore, inclined to think it probable that the development of the alcohol motor on these lines, and the diminution of the cost of commercial alcohol which we may anticipate, at any rate, on the Continent, will tend to the use of as pure alcohol as possible in long stroke high compression engines rather than to the adoption of a mixture of alcohol and petrol in motors more closely resembling those at present in use.

There are another set of considerations connected with the alcohol problem, which center round the type of carbureter employed. Among the most successful of these are the Longuemare and the Martha, which we reproduced in our last issue. In these it will be observed first, that the arrangements are constructed so as to produce an increased spraying or atomizing effect as compared with satisfactory types of petrol carbureters. Second, that arrangements are made by means of which the mixture of air and spray may be more completely heated by exhaust jacketing than is found necessary in the case of petrol. This is carried furthest in the case of the Martha carbureter, where the mixture of spray and air is taken round and round a branch of the exhaust pipe in a spiral passage, the arrangement consequently being very similar to the method of utilizing heavy oil, successfully adopted in the Milnes lorry, described in our last two issues. Arrangements of this kind are the outcome of practical experience, and presumably show that there is a greater tendency to redeposition on the part of alcohol vapor than in the case of petrol, as well as that a higher initial temperature is required for complete vaporization, but there is another consideration of high theoretic importance. It was clearly shown by Prof. Meyer that if all the water injected into the Banki engine is assumed to be turned into steam before the commencement of the explosion stroke, the efficiency comes out higher than if at that point in the cycle a certain proportion remains in the liquid form. The same conditions necessarily prevail in the case of the alcohol motor, and the thermodynamic function of the exhaust jacketing of the carbureter may, therefore, be looked upon as being to insure that all the water combined with the alcohol shall be in the form of steam by the commencement of the explosion stroke.—The Automotor Journal.

FLUORESCENT DYEING.

FLUORESCENCE is well known as a characteristic color effect produced by certain substances when exposed to laylight. The same effect can be produced by interweaving different colors. For example, if silk or highly-lustered wool is interwoven with yarns of a blue or pale-green color, the effects of the colors, together with the natural luster of the material, produce a fluorescent effect. It will probably be of interest to discuss how the same effect may be produced on ladies' pure wool piece goods. The effect must be produced by surfaces which create interference of light, or by fluorescent dyes. On small samples it is hardly possible to produce the play of color, but on large pieces it can be made evident, especially in a dress which is in constant motion. The best effect is produced by mixing lively blue and red dyes with yellow. A combination of blue and red shimmers little, and there are no sharp contrasts. From many experiments, the Berlin Farber Zeitung states that cyanol extra, a dyestuff well known as a good leveler, is the best dye to use for the blue. For the red can be used eosine, rhodamine, or irisamine, and the best is probably fast acid eosine G. It far surpasses the old marks of eosine, and with it the most delicate salmon and chamois colors can be dyed in the greatest purity with an acid bath. All eosines fluoresce strongly. The fluorescence of the solutions is orange and green. For the yellow, tartrazine is very suitable, or the various marks of fast light yellow, which are rather faster to light than tartrazine. The best effects are got when a full color is procured with fast acid eosine G, and then deadened to reseda, mode browns, etc., with cyanol extra. The effect is much improved, of course, with a good lustering finish. The following are two examples of recipes: (1) Chocolate: Dye for one hour at the boil with 1.4 per cent fast acid eosine G (hoechst), 0.22 per cent cyanol extra (cassella), 0.18 per cent tartrazine (B.A. and S.F.), 10 per cent Glauber's salt, and 4 per cent sulphuric acid. (2) Bluish gray: Dye for one hour at the boil with 1.25 per cent fast acid eosine G., 0.8 per cent cyanol extra, 0.06 per cent tartrazine, 10 per cent Glauber's salt, and 4 per cent sulphuric acid.

THE WORKING OF THE DEPARTMENT OF LABOR.*

By CARROLL D. WRIGHT.

ORIGIN.

THE Order of the Knights of St. Crispin was in a flourishing condition in Massachusetts in 1868 and 1869. In the latter year the order petitioned the Legislature for an act of incorporation, but the petition was rejected. In the same year two petitions had been filed with the Legislature, praying for a ten-hour law, but these petitions were indefinitely postponed. The rejection of the petition of the Knights of St. Crispin was probably the immediate turning point for the establishment of the Massachusetts Bureau of Statistics of Labor. It is generally believed that after the rejection of the petition fears were entertained by the leaders of the dominant party that the labor vote in the State might be alienated, and it was suggested by shrewd politicians that it might be politic to grant some concessions to the workingmen. Whether this belief is based on fact or not, it is true that after the adverse action on the petitions of the order and of the ten-hour men a bill creating the bureau was suddenly introduced in the senate at a late day in the session. It was promptly rejected on the 12th day of June, but on the 14th the vote rejecting it was reconsidered and the bill passed under a suspension of the rules. It was amended slightly in the house of representatives and passed that body and received the governor's approval June 22, 1869. Thus was created by the act of the Massachusetts legislature the first office in the world whose function was the collection of information relating to social and industrial conditions. The facts relative to the creation of that office indicate that the legislative branch of the State government had motives of its own for creating it, for from all that can be gathered it seems to be certain that the immediate stimulus to the creation of the bureau was political necessity or expediency. The legislature seized upon the recommendations which had been made by two special commissions, the first reporting February 7, 1866, recommending among other things, "that provision be made for the annual collection of reliable statistics in regard to the condition, prospects and wants of the industrial classes;" and the second, reporting January 1, 1867, unanimously recommending "that a bureau of statistics be established for the purpose of collecting and making available all facts relating to the industrial and social interests of the Commonwealth." These recommendations are all that can be distinctly classed as official action prior to the creation of the Bureau of Statistics of Labor in Massachusetts, which dates from June 22, 1869. The functions of that bureau were defined by law as follows:

"The duties of such bureau shall be to collect, assort, systematize and present in annual reports to the legislature, on or before the 1st day of March in each year, statistical details relating to all departments of labor in the Commonwealth, especially in its relations to the commercial, industrial, social, educational and sanitary condition of the laboring classes, and to the permanent prosperity of the productive industry of the Commonwealth."

The substance of this language finds a place in nearly every law creating a State bureau of similar character in this country, and also in the federal law organizing the United States Bureau of Labor and subsequently the Department of Labor. There are now in this country thirty-one State offices similar to that created in Massachusetts in 1869.†

The efforts looking to the establishment of a federal office date from April 10, 1871, when Hon. George F. Hoar of Massachusetts, then a member of the House of Representatives, introduced a bill "to provide for the appointment of a commission on the subject of wages and hours of labor and the division of profits between labor and capital in the United States." December 13, 1871, Mr. Hoar reintroduced his bill with certain amendments, and amendments were also pro-

* Revised from an article in the Cosmopolitan Magazine.

† The various State bureaus have been created as follows: Massachusetts, 1869; Pennsylvania, 1872; Connecticut, 1873; Missouri and Kentucky, 1876; Ohio, 1877; New Jersey, 1878; Illinois and Indiana, 1879; New York, California, Michigan, and Wisconsin, 1883; Iowa and Maryland, 1884; Kansas, 1885; Rhode Island, Nebraska, North Carolina, Maine, Minnesota, and Colorado, 1887; West Virginia, 1889; North Dakota and Idaho, 1890; Tennessee, 1891; Montana and New Hampshire, 1895; Washington, 1897; Virginia, 1898; Louisiana, 1900.

posed by Mr. Killinger. This bill passed the House of Representatives December 20, 1871, was brought into the Senate January 8, 1872, and was referred to the Committee on Education and Labor. It was reported back by Senator Sawyer, with certain minor amendments, and other amendments were proposed by Senator Wilson. Nothing more was done in that Congress, which was the Forty-second; but April 23, 1879, the legislature of Massachusetts sent a resolution to Congress asking for the establishment of a national bureau of labor, and May 5 of the same year Mr. Murch of Maine introduced a bill to establish a bureau of labor statistics. On December 8, 1879, Senator Hoar introduced in the Senate a bill to establish a labor commission. No action was taken upon either bill. April 12, 1880, in the House of Representatives, Mr. Warner introduced a bill to establish a bureau of mines and mining, a bureau of manufactures, and a bureau of labor statistics in the Department of the Interior. This bill was never consdered. January 9, 1882, in the House of Representatives, Mr. Belford reintroduced Mr. Warner's bill. December 4, 1883, in the Senate, Mr. Blair introduced a bill to establish a bureau of statistics of labor, and December 10 of the same year, in the House of Representatives, Mr. Willis introduced a bill to establish a bureau of statistics of labor and industries. December 11, the same year, Mr. Hopkins, in the House of Representatives, introduced a bill to establish and maintain a department of labor statistics. February 12, 1884, the Committee on Labor of the House, after considering various bills, reported the bill introduced by Mr. Hopkins, to establish and maintain a department of labor statistics, and this bill passed the House of Representatives April 19, 1884. It was received in the Senate on the 21st of the same month, and was reported back April 25, by Mr. Blair, chairman of the Committee on Education and Labor. May 22, 1884, Mr. Garland proposed certain amendments to this bill, as did Senator Aldrich. Out of these various bills introduced in 1883-84, an act establishing a bureau of labor in the Department of the Interior was framed and passed, and was signed by the President June 27, 1884. This act provided that "the commissioner of labor shall collect information upon the subject of labor, its relation to capital, the hours of labor and the earnings of laboring men and women, and the means of promoting their material, social, intellectual and moral prosperity."

The earlier bills to which reference has been made were introduced as the result of the establishment of the Bureau of Statistics of Labor in Massachusetts; the later bills, those introduced in the year 1879 and subsequently, resulted from the various petitions of labor organizations.

The United States Bureau of Labor was organized in January, 1885, and the Commissioner of Labor, February 4, 1885, addressed a letter to the Honorable Secretary of the Interior declaring the policy of the office, in which he said:

"It should be remembered that a bureau of labor cannot solve industrial or social problems, nor can it bring direct returns in a material way to the citizens of the country; but its work must be classed among educational efforts, and by judicious investigations and the fearless publication thereof it may and should enable the people to comprehend more clearly and more fully many of the problems which now vex them."

After the Bureau of Labor—as one of the bureaus of the Department of the Interior—had been in existence three years and had shown the character of its work, the Knights of Labor demanded that Congress should create a department of labor, to be independent of any of the general departments. To this end Congressman O'Neill of Missouri introduced a bill to establish a department of labor, and this bill was promptly passed by the House and the Senate, and was approved June 13, 1888, the act providing that "there shall be at the seat of government a department of labor, the general design and duties of which shall be to acquire and diffuse among the people of the United States useful information on subjects connected with labor, in the most general and comprehensive sense of that word, and especially upon its relation to capital, the hours of labor, the earnings of laboring men and women, and the means of promoting their material, social, intellectual and moral prosperity." The act defines the organization of the department and the duties of the commissioner, and provides for transferring the Bureau of Labor, its duties, etc., to the Department of Labor. The new department, therefore, simply continued the existence of the Bureau of Labor, but with independent functions. The head of the department was not placed in the cabinet, but occupied under the new law a position similar to that of the commissioner of agriculture before that department was made a cabinet office. The powers, duties, and efficiency of the Department of Labor were placed on a better footing than that which existed under the Bureau of Labor.

ORGANIZATION AND FUNCTIONS.

With this brief history of the origin of the United States Department of Labor, it is well to describe its organization and functions, as they really represent those of the various State bureaus. The Department is presided over by a commissioner, entitled "The Commissioner of Labor;" there is a chief clerk, a disbursing officer, stenographers, statistical experts, librarian, translator, and a proper corps of clerks, messengers, and watchmen. The grade of pay is the same as that pertaining to other federal offices. The functions of the Department are to collect and publish information, as the law defines, relating to the material, social, intellectual, and moral prosperity of laboring men and women. Under these broad powers the commissioner can undertake any investigation which in his judgment relates to the welfare of the working people of the country, and which can be carried out with the means and force at his disposal. He is obliged by law to make an annual report covering the results of his investigations, and he may make, in his judgment, special reports on particular subjects whenever required to do so by the President or either house of Congress or when he shall think the subject in his charge requires a special report.

Since November, 1895, the Department has published a bi-monthly bulletin.

The information under any investigation is usually collected on properly prepared schedules of inquiry in the hands of expert special agents, by which means only the information which pertains to an investigation is secured. Rambling and nebulous observations, which would be likely to result from an investigation carried on by inquiries not properly scheduled, are thus avoided. The great advantages of this method have been demonstrated by many years of experience. Sometimes the peculiar conditions accompanying an investigation admit of the use of the mail, but as a rule the attempt to collect information upon any given subject under investigation through the mail has proved a failure. With properly instructed special agents, who secure exactly the information required, who are on the spot to make any explanation to parties from whom data are sought, and who can consult the books of account at the establishment under investigation, the best and most accurate information can be secured, and in a condition for tabulation; in fact, sometimes under this method the tabulation is partially accomplished by the form of the inquiry and answer as shown by the schedule. It should be remembered that the Department of Labor does not attempt to secure information concerning all the people or all the establishments of a city or of the country. This character of work belongs to the census office and to the methods of general enumeration. The Department of Labor must secure specific information and on specific topics.

The question is often asked, How do people receive the agents of the Department? As a rule the reception is kindly, even if one declines to give the information sought. As representative and special facts are required, it is always found that if one establishment or one man from whom facts are desired declines to give them, some other establishment or some other man will be found sufficiently interested in the subject as presented to furnish the information. As time progresses the declinations are less frequent. The Department never allows the names of parties furnishing facts to be given in its reports, but it seeks every method of verification open to it. Thus confidence is secured, from the knowledge that in none of the reports have private interests been endangered. Through this confidence manufacturers in this and other countries have opened their books of account, their pay rolls, and their records to the agents of the Department. Estimates, hearsay statements, what a man thinks relative to a fact that can be ascertained—in fine, all variable elements—are carefully and strictly excluded and only original and positive data accepted. Even under this rigid method errors will creep into an official report, and sometimes a statistical conclusion will be, to a small degree at least, invalidated. Such an occurrence, however, is exceedingly rare in the history of the Department.

After the information is brought into the office the schedules containing it are subjected to most careful scrutiny, for the purpose of ascertaining whether there are any logical faults or incongruities in it. If such are found the agent furnishing it is called upon to verify his work. What I mean by "logical faults or incongruities" is this: for instance, the product of an establishment may be given at a certain sum and the raw material at another, the two being entirely out of proportion. Under such circumstances a schedule could not be accepted, and there must be a re-examination. When the schedules are all verified the classifications and tabulations are made, every calculation being subjected to rigid verification in the preparation of copy for the press, and in the reading of the proof all original calculations must again be verified, all references re-examined, and every care taken to guard against typographical as well as clerical errors. Figures made by the officers of the Department in their analysis or by the more skilled expert in it are never allowed to be printed until verified.

THE CHARACTER OF THE WORK.

The altruistic spirit of the age undertakes to ascertain what social classes owe to each other, and statistical science helps the world to the answer. Generally three answers may be given to the inquiry. If we say social classes owe nothing to each other, then society retrogrades to civilized heathenism, and neither social science nor statistics has any place among the departments of human knowledge. If the answer is that social classes owe everything to each other, then socialism is the logical form of social organization. But if the answer is in the spirit of "Inasmuch as ye have done it unto the least of these, ye have done it unto me," then we have put the Christian religion into social science, have answered the question rationally, and must have the light of facts in order that the action, either of governments or of communities, under the spirit of this answer shall not be either futile or absurd. Altruism is the rule of the day as against the individualism of the past. Its tendency must be guided by facts, and facts can only be gained by the most faithful application of the statistical method, not only in the gathering thereof, but in the application. Personal observation on which to base conclusions is not sufficient. Very many illustrations might be given of this fact, but they are hardly essential. The assertion can be made, however, without fear of contradiction, that very many conclusions have been deduced from mere observation which the facts, when properly classified, showed were erroneous. The attempt to compare criminal conditions through criminal statistics, the use of city criminal statistics as against those belonging to the country, the acceptance of one line of satistics relative to moral conditions when two or three are essential—all these directions in which the statistical method is used teach us that ordinary observation is too faulty, at least for legislative purposes. So the character of the work of an office having the functions of the Department of Labor must be based upon the Baconian idea of securing the facts before taking the action.

The character of the work of the Department has been critical, involving the closest application of the statistical method, and has been free to a large extent, if not entirely, from any desire to argue a point. If there have been errors in the origin of investigations they have arisen from a misconception of what constitutes labor statistics. A glance at the different volumes already issued may perhaps give the best evidence as to whether the Department has properly construed the character of its work. The Department has issued fifteen annual reports, nine special reports and thirty-three bi-monthly bulletins.

To my mind, all the facts which have so far been gathered and published by the Department bear, either directly or indirectly, upon the industrial and humanitarian advance of the age, and are all essential in any intelligent discussion of what is popularly known as the "labor question." Labor statistics must not be considered as simply statistics relating to narrow fields, but, in the language of the law creating the Department of Labor, they should relate to the "material, social, intellectual and moral prosperity" of all concerned; and this means the material, social, intellectual, and moral prosperity of society itself. If the industrial elements of a nation are not progressing intellectually and morally to a higher social plane, little can be expected from all the educational efforts which may be made under the conventional and academic methods. There must be the broader education which comprehends the industrial freedom of men and women as a prerequisite to intellectual and political freedom.

Kindly criticism is sometimes made upon the Department by its friends that it does not do this or that—that it has not taken up investigations that are most pressing in their nature. The answer to this is that the Department is limited in many directions. It would be a very great piece of maladministration to undertake an investigation that could not be carried to reasonable completeness, to undertake a work which the Department has neither the means nor the equipment to carry on, and very many of the suggestions which are in the kindliest way made to it are suggestions which would involve the expenditure of hundreds of thousands of dollars to carry out, and the employment of a force of hundreds of people instead of the use of the means and the force at the command of the Department. There has never been a suggestion made relative to the work of the Department that the commissioner would not gladly have carried out had he had the means to do so. And yet Congress has been very liberal. Commencing with $25,000 as the annual appropriation for the Bureau of Labor, Congress now appropriates more than $175,000, exclusive of printing, for the administration of the Department, and so far as I know there has been no inclination on the part of the House, the Senate, or the President to in any way abridge or interfere with the work of the Department. On the other hand, it has met with the most generous confidence on the part of Congress and of the President, and been aided in all reasonable ways in bringing its work to a high standard of excellence.

This is in evidence through the continued demand for the reports of the Department. Congress is constantly supplying new editions of exhausted numbers, so that on the whole the Department is able to furnish libraries and students with most of its publications. One of the most gratifying demands comes from reading clubs which are being established rapidly all over the country by labor organizations. The study of economic facts by such organizations ought to be stimulated in every way, and the Federal Government, through its Congress, does not hesitate to meet this demand.

The question is often asked why the Department does not furnish data each year showing the condition of labor and industrial matters continuously. This would be a desirable result to be accomplished, but it would involve a very large expenditure of money and practically a census of manufacturing establishments. This can be done only at the decennial census of the United States. In order to give complete statements of an industry the Department would have to canvass all the establishments in that industry, and hence in all industries. It will be seen at once that this is an impossibility. The Department is, therefore, content to make special investigations each year, the results of which, if of sufficient importance in volume and value, are published in its annual report, and if of minor importance in volume, although maybe not in value, they are published in the bi-monthly Bulletin. The special reports authorized by Congress enable the Department to publish the results of special investigations which cannot be included in either of the other forms of publication.

The Department can determine many things by the statistical method, and it must work emphatically on that method. It is often said that it should undertake the agitation of certain features of reform; in other words, that it should become the instrument of propagandism. But when this proposition is made, the question should be asked, Whose ideas of reform should be adopted, of what propositions should it become the propagandist, and to what extent should it argue for or against the platforms of this or that party or organization? It seems to me that all men who comprehend the value of accurate knowledge must see at once that for the Department to enter upon such a course would result in its immediate abolition; that should it become the advocate of any theory it would thereby become partisan in its work and thus destroy its own efficiency. If the Department advocates a proposition it necessarily takes the position of an advocate, and hence a partisan, and lays itself open to the charge of having collected facts to substantiate and bolster up its position, or of having neglected to secure facts which might antagonize such position. Whenever the head of the Department of Labor attempts to turn its efforts in the direction of sustaining or of defeating any public measure, its usefulness will be past and its days will be few. It is only by the fearless publication of facts, without regard to the influence those facts may have upon any party's position or any partisan's views, that it can justify its continued existence, and its future usefulness will depend upon the non-partisan character of its personnel. And what has been said in regard to the Federal office applies with equal force to the State offices of kindred nature. Practically, the Federal and State offices are working along legitimate lines. They have published over 400 volumes.

The British, French, Belgian and Austrian governments, as well as those of New Zealand, New South Wales, the Dominion of Canada, and the Province of Ontario, Canada, have followed the example of the

United States in establishing bureaus of statistics of labor, usually adopting the American plan. The statistical bureaus of several other foreign governments, particularly Germany, Italy, and Sweden, publish labor statistics as a part of their regular official work. All these offices are working successfully, and are furnishing economic data which are used by the legislatures of the different governments and wherever facts are essential for the proper discussion or consideration of industrial conditions.

The future of usefulness open to this chain of offices is hopeful, indeed, and it is apparent that they are engaged in a grand mission in securing that information which is essential for the proper understanding of industrial conditions. The results they are bringing out constitute a most valuable series of contributions to social and political science. The popular education of the masses in the elementary facts of political and economic science is the greatest educational end of the day. The bureaus of statistics of labor are emphatically in the line of facilitating this grand work by their faithful investigations into all the conditions where facts should be known and into all causes of bad conditions of whatever nature, and by their fearless promulgation of the results of their investigations. To attempt to turn such a sphere of labor to base purposes is a crime not easily punishable by law, but which can be punished by an unwritten law which reaches the violator through a decree more to be dreaded than any merely judicial order or sentence—the sentence public opinion passes upon the man who prostitutes a public trust in the cause of humanity.

[Concluded from SUPPLEMENT No. 1372, page 21982.]

FROM RAFT TO STEAMSHIP.

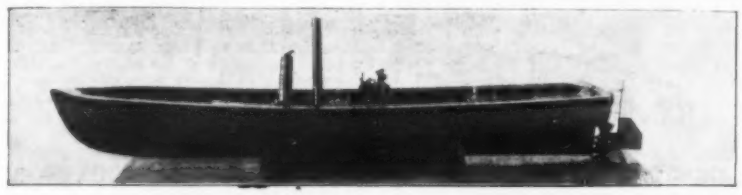
By RANDOLPH I. GEARE.

PART IV.—THE STEAMSHIP.

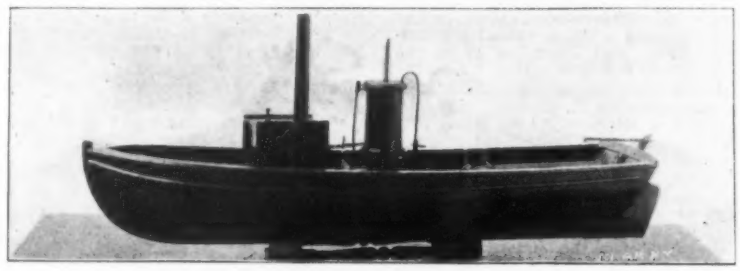
IN 1786 John Fitch tested his steamboat on the Delaware River, and Congress, then in session in Philadelphia, adjourned to witness the experiment. In writing to a friend five years later to borrow money for the completion of his vessel, he said: "This, sir, whether I bring it to perfection or not, will be the mode of crossing the Atlantic in time, for packets and armed vessels." A contrary opinion was expressed by one Dionysius Lardner, who nearly forty-five years later (only seventy years ago!) said in a lecture: "As to the project, which is announced in the newspapers, of making a voyage direct from New York to Liverpool [by steamship], it is, I have no hesitation in saying, *perfectly chimerical*, and they might as well talk of making a voyage from New York or Liverpool to the moon." Thus there were two quite opposite opinions on the subject; but if Dr. Lardner were now alive, he would probably wish he had been more cautious in his utterances. Long before Fitch had built his boat, which was known as "The Steamboat," Denis Papin expected to apply his atmospherical engine to propelling boats against the wind. Apparently, however, he made no direct experiments to that end. Another early inventor, Capt. Thomas Savary, an Englishman, obtained a patent in 1696 "for rowing ships with greater ease and expedition than had hitherto been done by any other," and in 1698 expressed the opinion that steam might be utilized for propelling ships. By some historians, Jonathan Hulls, born in 1699, is believed to have been the original inventor of the steamboat, but on the other hand there is no evidence that his ideas actually took definite shape. The popular estimation of him, which was probably entirely too low, seems to have been about on a par with that of Darius Green, of flying-machine fame, for of poor Hulls it was written:

"Jonathan Hulls,
With his patent skulls,
Invented a machine
To go against wind with steam;
But he being an ass,
Couldn't bring it to pass,
And so was ashamed to be seen."

There is little doubt, however, that Hulls was a serious and intelligent worker, and if his resources had been greater, he would probably have succeeded in placing before the world his "ingenious and practicable mechanism for propelling vessels by a condensing steam-engine and by paddle-wheels." In the same year as that in which John Fitch built his boat, James Rumsey, of Shepherdstown, Va., also constructed "a boat which was to be wrought altogether by steam."

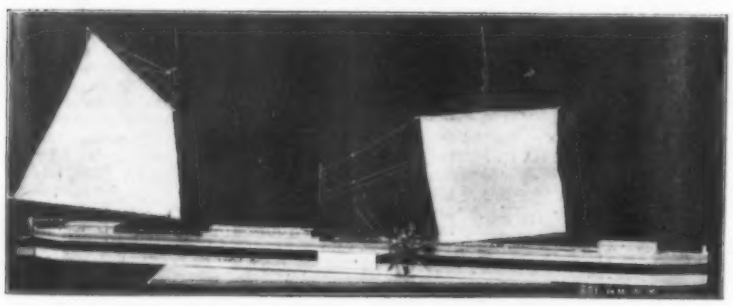


FIRST TWIN-SCREW PROPELLER; BUILT BY CAPT. JOHN STEVENS.

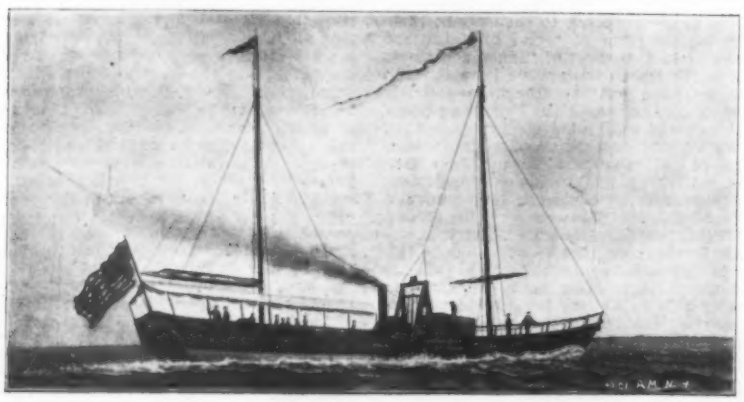


RUMSEY'S STEAMBOAT.

JOHN FITCH'S FIRST STEAMBOAT.



THE "CLERMONT," BUILT BY FULTON.



THE "PHŒNIX," BUILT BY STEVENS.

Gen. Washington, who witnessed the launching of this boat, afterward expressed his belief that "the discovery is of vast importance, and may be of the greatest usefulness in our inland navigation."

After an interval of eighteen years, during which many experiments in steamboat construction were made—some of them successful—Capt. John Stevens, of Hoboken, N. J., built the first twin screw-propeller. The cut of this boat shows the screws very plainly. It was 24 feet 8 inches long, 6 feet 1 inch beam, and 2 feet 4¼ inches deep. The engine was of the kind known as "high-pressure condensing." The cylinders were 4½ inches in diameter by 9-inch stroke. The tubular boiler contained twenty-eight copper tubes 1½ inches in diameter. It had an average velocity of four miles an hour, while for a short distance its speed could be nearly doubled.

The first steamboat to be a commercial success was the "Clermont," built by Robert Fulton. It made its first trip from New York to Albany in August, 1807. It was 175 feet long and only 12 feet wide. The central portion of the boat was originally open, with no covering over the engines or paddlewheels, which latter were 15 feet in diameter. After making several successful trips between the cities mentioned, she was entirely remodeled, being in her reconstructed form something like a sloop. Her hull was shortened to 130 feet, while her beam was increased to 16 feet. She was now furnished with two masts, deckhouse and cabins, besides being equipped with new boilers of increased capacity.

The next illustration shows the "Phœnix," constructed by Capt. John Stevens in 1808, and the *first steamboat to navigate the ocean*. She was 103 feet 3 inches long, 16 feet wide and 6 feet 9 inches deep. Her first trip was from Sandy Hook to Cape May. On her passage she was damaged by storms, and sought shelter in Barnegat Bay. After reaching Philadelphia she ran for a number of years as a packet on the Delaware River. She was wrecked at Trenton, N. J., in 1814.

But all these inventions, wonderful as they are, pale before the feat accomplished by the "Savannah"—the first steamship to cross the ocean. She was built by Francis Fickett at Corlaers Hook, New York, launched in 1818, and made her first transatlantic trip (which occupied some twenty-two days) in 1819. She was 350 tons burden, 120 feet long, 29 feet beam, 13 feet 6 inches deep. Her paddlewheels were so constructed that they could be hauled in on deck whenever progress by sail-power alone was found desirable. When ready for sea she had cost $50,000. She was equipped with one inclined, direct-acting, low-pressure engine of 90 horse power. The following advertisement in the New York Mercantile Advertiser of March 27, 1819, regarding her maiden trip, will probably be read with interest:

"By an advertisement in this day's paper it will be seen that the new and elegant steamship 'Savannah' is to leave our harbor to-morrow. Who would have had the courage twenty years ago to hazard a prediction that in the year 1819 a ship of 300 tons burden would be built in the port of New York to navigate the Atlantic propelled by steam? Such, however, is the fact. With admiring hundreds have we repeatedly viewed this prodigy, and can also bear witness to the wonderful celerity with which she is moved through the water. On Monday last a trial was made of her speed, and although there was at no time more than an inch of steam upon her, and for the greater part not a half inch, with a strong wind and tide ahead, she went within a mile of the anchoring ground at Staten Island and returned to Fly Market Wharf in 1 hour and 50 minutes. When it is considered that she is calculated to bear 20 inches of steam and that her machinery is entirely new, it must be evident that she will with ease pass any of the steamboats upon our waters.

"Her cabin is finished in elegant style, and is fitted up in the most tasty manner. There are thirty-two berths, all of which are staterooms. The cabin for ladies is entirely distinct from that intended for gentlemen, and is admirably calculated to afford that retirement which is so rarely found on board of passenger ships."

The London Times, alluding to the same event, printed the following: "The 'Savannah,' a steam ves-

sel, recently arrived at Liverpool from America—the first vessel of the kind which ever crossed the Atlantic—was chased the whole day off the coast of Ireland by the 'Kite,' revenue cruiser on the Cork station, which mistook her for a ship on fire."

And this was only eighty-two years ago!

Contrasted with the achievements of our present superb ocean fliers, how puny the efforts of two generations ago now appear. In this comparatively brief interval speed has been increased from 8½ to 23 knots; the time on the voyage has been reduced to nearly one-fourth; ships have been more than trebled in length and about doubled in width, and the displacement has been increased tenfold. The engine power is forty times greater; the ratio of horse power to the weight driven has been increased fourfold. The coal consumption (measured per horse power per hour) has been reduced to one-third. In 1840 each ton of machinery and boilers produced only two horse power; now each ton develops from six to seven horse power. At the old rate of coal consumption 9,000 tons (instead of 3,000 as at present) would have been required for a voyage across the Atlantic.

SAVAGE NAVIGATORS' CHARTS.

THIRD and most wonderful of the three things which the wise proverb maker of antiquity declared to be too wonderful for him stands the way of a ship in the midst of the sea. In our time mathematics and navigation have made the mystery as simple as one could wish. There is no secret at all about the way courses are laid from port to port, whether in vessels propelled by steam or in the slower and more picturesque "wind jammers." Yet despite this general acquaintance with the principles of navigation, not even the most abstrusely learned naval officers can venture to explain how it is that a race of savage seafarers in the very heart of the equatorial Pacific find their way over enormous stretches of barren sea from island to island without compass or even the simplest form of instrument for determining position.

That such is the case is true. For a long time it was disbelieved, and with reason, for it is indeed incredible. At odd intervals some vagrant copra trader would return from a cruise among the Line Islands and exhibit among his curiosities in Sydney or San Francisco what he called a native chart. It was never anything but a network of dry twigs interlaced apparently at random and tied together at every point of intersection. Here and there upon this framework were tied either shells or shark's teeth, or the scarlet jequirity seeds with the bright black eyes. Each such network was generally about a yard square. As the copra traders could offer no explanation of the way in which these charts were used for navigation, as it seemed utterly unreasonable that such a device could be of any use at all, and finally, as traders in the South Sea Islands were not supposed to hesitate at flirting with the truth, these stories were for the most part promptly disbelieved. It is only natural that incredulity should attend the relation of such an incomprehensible device in navigation. Yet it is true in every particular, although the more carefully it is examined and investigated the less it is found capable of explanation. These stick charts enable savage sailors to find their way from island to island. Without them they will not go to sea.

It is fully appreciated that this is taxing the confidence of the reader who knows the least about navigation. It is a great deal to ask one to believe that by means of a bundle of sticks tied with shells and bright beans a race of ignorant savages can make unerring landfalls over complicated courses of hundreds of miles, and do this without the use of compass or other instrument of precision, and without any knowledge of the stars. That it is literally true I can vouch on the score of personal witness of the employment of these charts, of the unanimous statement of the islanders who have employed them from time immemorial, and lastly, from the statements of many naval officers of the British and German services who have seen the use of the charts and who have vainly endeavored to find some reasonable explanation for a series of remarkable facts which they have convinced themselves is beyond all dispute. The native makers and users of these stick charts make no secret about them or the method of their employment. It is only that no white navigator has ever been able to make head or tail out of the explanation so freely offered.

The islands in which these charts are in use form the Marshall group in two chains known respectively as the Radak and the Ralak. They lie just north of the equator and with the Gilberts, the Carolines, the Ladrones, the Palaos and many scattered islets form the grand division of the Pacific to which has been applied the name Micronesia. They lie directly in the strong westerly set of the equatorial current, which, however, is deflected by the numerous atolls and reefs into local streams, which may run north or south, or even establish a reflex flow toward the east again. These are local conditions which it is difficult to keep track of and which add to the difficulties of navigation even for those who enjoy all the advantages of scientific methods and appliances. Furthermore, lying as they do in the equatorial doldrums, the Marshall Islands have neither the steady southeast trade which is found to the south nor the northeast trade which rules to the north of them. There is no characteristic wind, calms are frequent, and the winds may blow from any point of the compass. The navigation of these Micronesians, therefore, must be founded on an entirely different basis from that of the Polynesians in the two trade-wind regions, who have made themselves such reputations as adventurous navigators.

Such in brief summation is the statement of the condition under which these island savages have developed a system of navigation. Now pass to a closer examination of the aid to navigation which unaided they have developed for their needs.

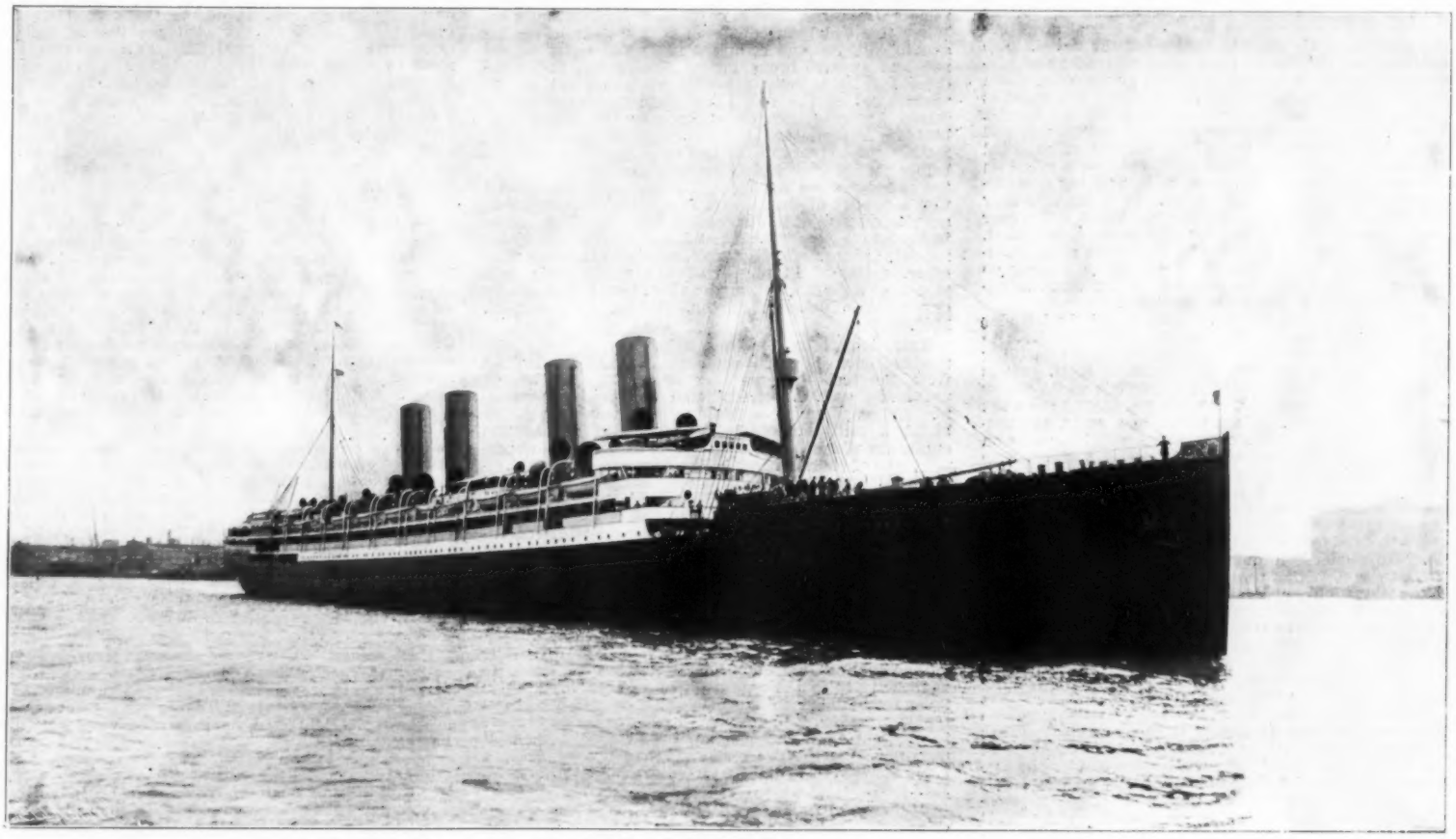
It has already been stated that they have no compasses. It should be said that it would be utterly impossible for the compass ever to develop with them, for the simple reason that their islets are utterly devoid of metals in nature, and certainly the phenomena of magnetism could never arise upon their attention. Even the sun is scarcely available for the determination of direction, for it is sometimes north of them, sometimes as far to the south, and between its two extremes it opens a wide angle which would puzzle such simple observers. Why the more conspicuous fixed stars have not sufficiently attracted the attention of these savages to serve as aids in sailing and to receive names is a matter not so easily explained. Still such is the case. Their charts have no connection whatever with the stars for the determination of position or the laying of a course.

These Marshall Island charts are made of twigs tied in complicated angular patterns. The twigs are taken from the shoots of the native trees, peeled off the bark and carefully dried. Then they are rubbed down on coral slabs until they are at least approximately even in diameter throughout. If there are any twists or angles in the twigs these are removed by steaming and bending, after which the twigs are baked in hot sand. They are finally finished off smooth with sharks' teeth and the skin of the same fish, which is frequent in those seas.

These sticks are seldom found larger than a common lead pencil, and just as seldom smaller than one of the familiar slate pencils. Where there is use for a finer line recourse is had to the midrib of the cocoanut leaflet, which is very flexible, and even when at its driest is so tough as scarcely to be broken. Out of these materials the chart-maker builds up his chart according to rules of procedure based on his own knowledge, and which, while perfectly willing to expound, and not making any secret of, he finds it impossible to explain in such a manner as to carry understanding to persons of the superior races. Large sticks and small ones are tied together with cocoanut fiber at every conceivable angle, and cocoanut midribs are entwined in additional confusion. Certain of these corners are decorated with a shell of one kind or another, certain other intersections have several shells, others have jequirity seeds, yet others are left undecorated. Similarly, on the portions of the sticks between intersections there are similar decorations. And these things are not mere ornament; they carry essential information to the navigator who depends on them to find his way over the sea.

It should be said that these lines of the stick charts are not disposed at regular intervals nor at right angles. They have, therefore, no connection with parallels and meridians, for the makers are entirely ignorant of mathematical geography. It is quite impossible to institute any comparison between the native charts and those produced by naval surveys, for the reason that the various islands are not included by marks on these stick systems. One native navigator, when questioned as to the reason for this lack and when a real chart was placed before him for examination expressed himself with much scorn of his civilized rival. Any man, he said, could tell an island when he saw it, but the true need of a chart was to find the corners of the sea which did not show boldly in the sight; for if you only could find the right corner in the sea it was easy enough to sail along the proper stick to reach the island you were bound for. What is meant by this mysterious expression, the corner in the sea, will come up later for further elucidation.

According to the best native authority, there are two distinct classes of stick charts, one embracing the whole world as known to Marshall Islanders, the other class being subordinate thereto and dealing more in detail with individual archipelagoes. Marshall Island geographical knowledge restricts the world to their own archipelago, with the Carolines, at a distance of some twelve degrees to the west, and the Gilberts, at a nearly equal distance to the southeast. Thus it will be seen that a world chart of these savages covers a distance, after allowing for the space occupied by each of these archipelagoes, of about thirty degrees. It must be acknowledged that this is a very creditable geographical showing, if one takes into consideration the difficulties under which they labor. According to the same native authority, it has been many generations since these world charts have been used in the direction of the Gilbert Islands. No person now lives who knows how to use the charts in that direction, for it must be said that the charts cannot be used except by those who have been taken over the course by those who have been there before and are willing to



Average speed ,or whole trip, 23.5 knots per hour.

NEW HAMBURG-AMERICAN LINER "DEUTSCHLAND," HOLDER OF TRANSATLANTIC RECORD.

supplement the device with oral instruction. Thus it has come about that in the vicissitudes of savage existence all those who possessed the knowledge of how to use these world charts in the southeastern voyage to the Gilberts have vanished without communicating to others their knowledge. The old construction is repeated on all modern charts, even though it is no longer of use.

In the other direction the additional information has been handed down unimpaired, and the Caroline voyage is frequently made. This has been particularly the case in recent years since the Marshall Islanders have acquired various sloops and schooners from white men and are able to make such a long voyage with greater profit and comfort than in their aboriginal canoes.

Of the group charts there is an abundant supply for the home archipelago in its two chains, as of course is only to be expected. There are also charts of the Caroline Islands designed to be used after the landfall has been made on the world chart. Probably there no longer exist in the archipelago itself any specimens of the chart for the Gilbert Islands. After the knowledge of the Gilbert voyage had perished, the detailed chart of that group became useless. Traders and naval officers visiting the islands and seeking to buy charts as curios would be accommodated from those which had outlived their usefulness. Most of such purchases brought back from the land of savage peoples become rubbish at home and are destroyed. But some of these charts have found their way into museums in Europe. Neither in the Gilberts nor in the Carolines have the people the slightest knowledge of the art of navigating by means of these charts, whether general or of their own group.

According to the method of the Marshall Island pilots, the use of these stick charts lies in comparison with the sea, for each corner of intersecting sticks represents a corner in the sea. In practical operation the pilot takes his place in the bow of the vessel. The chart is laid out flat in some place where he can conveniently refer to it, and is lashed or weighted down in such a way that the stick along which the vessel is sailing is brought into alinement with the course. The pilot devotes his whole attention to the sea, and when some important point is about due or expected all aboard who have the wisdom of the charts give him the benefit of their assistance in identifying the particular point in the empty water. In doing this they aid the sight by tasting the water. When the corner in the sea has been reached the pilot refers to his chart, and in accordance with what he sees there gives directions whether to continue along the same course or go on another one, and the position of the chart is adjusted to conform to the new direction.

Now, what is this corner in the sea that the islander can see, and even taste? Frankly, it is impossible to tell. It is certain that the islander sees something there. There is no medicine or magic in it. He is ready and anxious to point it out to his white fellow voyager, and is disgusted because you cannot see what is so plain to him. When asked to give an explanation, his stock reply is a comparison with two paths on the beach. You are on one path and you come to another which intersects it. If the new path is your road to destination you turn and follow it in the proper direction. So at sea you watch until you come to the intersection of the paths, which is perfectly clear to him to see, and dependent on your ultimate destination you keep on your own path or turn off to the new one. Others make reference to two streams of water which come together and form one; if you are going up the stream you have no difficulty in seeing where the two forks come into one.

This certainly sounds absurd. No one familiar with the sea can imagine any such system of paths and rivulets recognizable within it. Absurd, irrational, impossible, this may be argued to be all of these. Yet the fact remains, none the less, that by watching these corners in the sea, this race of hardy navigators has been able to find its way over thousands of miles of sea without the use of any instruments besides the network of sticks, with its shells and beads. That such is the case does not rest on the word of mere beachcombers of the South Sea, but has been proved by naval officers who have been piqued to confess the existence of something in navigation which with all their scientific training they could not explain. That there is no humbug on the part of these native pilots, appears very plainly in their conduct when it happens that they have lost a corner. They waste no time in a search which they know would be vain. They stand away westward until some land is sighted. This gives them a new departure; they are once more on their chart and may proceed on the interrupted voyage.—Forest and Stream.

CONTEMPORARY ELECTRICAL SCIENCE.*

ATMOSPHERIC ELECTRICITY.—The general result of atmospheric observations to date shows that the earth has a permanent negative charge, and the atmosphere a permanent positive charge, which probably balance each other and make the earth act outwardly as a neutral body. The positive charge is greatest in the case of fog, which probably prevents a great number of the heavier positive ions from reaching the surface of the earth. The source of the ionization may be the ultraviolet light of the sun, but H. Geitel prefers to seek it in the spontaneous ionization of the air. The negative ions, many of which are, no doubt, free electrons, reach the earth's surface sooner on account of their superior mobility, and the negative charge thus imparted to the earth is kept from growing indefinitely by the repelling action exerted by it upon the negative ions. But when the negative ions are formed below the surface, as, for instance, in a forest or a landscape covered with vegetation, the earth's field is unable to exert this repelling action, and hence the ionization of the atmosphere is encouraged by vegetation. The conductivity of the air is greatest where the air is purest, i. e., on mountains or in high latitudes, on account of the superior mobility of the ions in pure air.—H. Geitel, Hamburg Scientific Congress, 1901.

*Compiled by E. E. Fournier d'Albe in The Electrician.

TREATMENT OF TUBERCULOSIS.—G. Kaiser has attained some remarkable results by treating pulmonary consumption and other diseases with pure blue light. He finds that the bacilli of tuberculosis are killed off in about 30 min. by the light of an arc lamp concentrated through a lens containing methylene blue or through glasses giving blue light of equal purity. The liquid lens is preferable, as it absorbs all the heat rays, but then a constant circulation of liquid must be maintained through the lens. These rays are capable of penetrating the human body, as was proved by taking a print of a negative tied to the back of a patient who was illuminated with blue light in front. It is, therefore, possible to reach the bacilli in the lungs and to kill them all with blue light. Two patients treated at an advanced stage by this method showed a great improvement after six days, and the author is about to carry out further experiments on a large scale. Incidentally, he mentions that blue light diminishes pain, and acts as a mild anæsthetic, but it must contain none of the rays of the red end of the spectrum.—G. Kaiser, Wiener Klinische Wochenschr., No. 7, 1902.

IONIC INDUCTION.—Mrs. Ayrton describes some experiments which may, perhaps, be fitly designated by the above title. They consist in the discharge or charge of an electroscope by means of a charged body placed at a distance. The most striking experiment of the series was performed as follows: A positively charged glass rod was brought to within 200 cm. of an uncharged electroscope. A candle, also positively charged, was placed between the rod and the electroscope, but nearer to the rod. The leaves then diverged, and the electroscope was found to have acquired a positive charge. In another experiment the candle and the electroscope were placed 150 cm. apart and a negative charge given to the electroscope. Result—no leakage. A glass rod was then rubbed, brought up to the candle on the side remote from the electroscope, and then withdrawn. When this had been done several times the leaves began to collapse, and collapsed in jerks, each time the rod was excited, brought near the candle, and withdrawn. The collapse appeared to take place at the withdrawal of the rod. The same results were obtained by charging the electroscope positively and bringing rubbed sealing wax up to the candle. The further the distance of the two apart, the longer was it before the leaves began to collapse and the slower was the collapse when it began. The authoress also found that a red-hot platinum wire is capable of discharging an electroscope at a distance of 300 cm. The candle in the above experiments could also be replaced by an insulated saucer of cotton wool, saturated in turns with ether, methylated spirit and dilute sulphuric acid placed at a distance from the electroscope, but not by dry carbon dust.—H. Ayrton, Nature, February 27, 1902.

RADIO-ACTIVE LEAD.—From a large quantity of the mother-liquor of barium-radium bromide, resulting from the technical working of about 2,000 kg. of uranium ore, F. Geisel separated (by means of ammonia and consequent purifying with sulphuric acid) about 3 milligrammes of an intensely radio-active substance which behaved like lead, and resembled preparations of radium in its action (compared on the phosphorescent screen). After a year had elapsed it still exhibited strong radiation. The author therefore asked M. Demarçay to undertake an exact spectroscopic examination of the residue after treatment with concentrated hydrochloric acid. The examination showed that the spectrum was principally that of lead. Iron, magnesium, and the few other metals were also present, but lines of radium were absolutely wanting. Two new lines were found at 4116.8 and at 3659.6 respectively, both extremely weak. The latter may also be a line belonging to either iron or air. The author inclines to the belief that the lead owed its radio-activity to the quantities of radium with which it was associated in the original ore. He maintains that the "radio-lead" described by Hofman and Strauss is different from the substances now described, as it shows a different spectrum and has not as great a radio-activity.—F. Giesel, Chem. News, February 21, 1902.

ELECTRICITY IN DENTAL SURGERY.—The employment of anæsthetics in dental operations is open to the objection that the risks or inconveniences incurred by the patient are out of proportion to the gravity and pain of the operation. Even local anæsthetics, such as cocaine or ethyl chloride, introduce undesirable elements into the circulation, and ice as a local anæsthetic is usually insufficient. L. R. Regnier and Henry Didsbury therefore advocate the use of D'Arsonval's high-frequency electric currents for purposes of painless dentistry. The current is applied through a molding of the part to be rendered insensitive. The interior of the molding is covered with metallic powder and a layer of tinfoil. To absorb the heat produced by the current the tinfoil is further covered with a layer of asbestos paste. The statistics of cases dealt with are very encouraging. In 15 cases of extraction of teeth with one root there were 13 cases of complete anæsthesia. The patient is enabled to follow the whole operation of removing the teeth in a waking condition, and a nervous patient will sometimes make some gesture of defense, but will admit afterward that he felt no pain. The authors have also successfully applied the method to other dental operations.—Regnier and Didsbury, Arch. d'Elect. Médicale, February 15, 1902.

IONIZATION OF LIQUIDS BY RADIATION.—P. Curie has made the important discovery that radium rays and Roentgen rays are capable of imparting a conductivity to a liquid dielectric. The liquid is placed in a metallic vessel into which a tube of thin copper is plunged. These two metallic pieces serve as electrodes. The vessel is maintained at a positive potential by means of a battery of small accumulators, one pole of which is put to earth, while the tube is connected with an electrometer. This tube is also surrounded by a guard tube to prevent any current traversing the air. A small vessel containing a radium preparation can be placed at the bottom of the inner tube. The rays act upon the liquid after traversing the glass wall and the wall of the copper tube. When working with Roentgen rays, the latter are made to enter through the bottom of the copper vessel containing the liquid. All liquid dielectrics show an increase of conductivity by the action of both kinds of rays, but to prove this increase it is necessary that the original conductivity of the liquid should be small. Both classes of rays give effects of the same order of magnitude. As in the case of gases, the current remains proportional to the tension up to a certain limit, but this limit is much higher in the case of liquids than in the case of gases. It is, in fact, difficult to prove the existence of the saturation phenomena observed in the case of gases, as there is no sign of saturation below 450 volts. But if the ionization is lowered by employing much more feeble rays it is found that the proportionality between difference of potential and current is no longer maintained, and that some kind of saturation is indicated, as in the case of gases. Vaseline oil is much less sensible to the action of the rays than petroleum ether. Liquid air which has boiled for some time in the vessel is more sensitive to the rays than liquid air which has just been poured in. The conductivity due to the radiation is reduced by only 10 per cent in passing from a temperature of 10 deg. to —17 deg., and no effect whatever is produced by lowering the temperature of the radium preparation, even down to the temperature of liquid air.—P. Curie, Comptes Rendus, February 17, 1902.

A NEW ELECTRIC THERMOMETER.—If the temperature of any region cannot be directly determined with an ordinary thermometer it is usual to employ a thermo-electric couple or a platinum thermometer. These instruments have the advantage of following all the changes of temperature very rapidly. When that is not required, and when for other reasons the instruments mentioned are not advantageous, G. Meslin proposes the novel expedient of employing a Clark cell for determining temperatures. The temperature coefficient of the E. M. F. of the Clark cell is pretty high, being about 0.5 per cent per degree, and the circuit may be so arranged that the observations are made by a null method, and that the temperatures are measured in terms of resistance. In the author's arrangement the principal circuit contains two resistance boxes of about 30,000 ohms, an accumulator, and a double key, which enables the observer to close, first, the principal circuit, and then the derived circuit containing the galvanometer and the Clark cell. The resistances may be so arranged that 1 ohm corresponds to one-tenth of a degree, and fractions of degrees may be accurately measured.—G. Meslin, Comptes Rendus, February 17, 1902.

ELECTRIC DISPERSION IN THE ATMOSPHERE.—A. Gockel has made observations of the dispersion of electric charges in the atmosphere of Southern Algiers and on the coast of Tunis. In general he found a higher coefficient of dispersion in those countries than in Germany, amounting, indeed, to as much as 10 per cent per minute. But the potential gradient was less marked, being only about 35 instead of 100 volts per meter. There was a marked daily variation of the dispersion. Starting at about 3 per cent per minute at sunrise, it increased to 10 per cent in the early afternoon. A minimum of 1 per cent per minute occurred about half an hour before sunset owing to the prevalence of dust and vapor. This was specially marked in the desert, but not at the seaside. A minimum of dispersion coincided as usual with the maximum potential gradient, which rose as high as 150 volts per meter. During a sirocco storm the dispersion on the coast of Tunis reached a very high value. The author does not agree with Elster in thinking that the dispersion in the interior of the continent is less than at the coasts.—A. Gockel, Physik. Zeitschr., February 15, 1902.

INDUCTANCES MEASURED BY THE SPEAKING ARC.—Duddell's experiments have shown that if a continuous-current arc is provided with a derived circuit comprising a condenser of capacity, C, and inductance, L, the arc under certain conditions gives a very pure note, having the period

$$T = 2\pi\sqrt{CL}$$

For capacities of 7 microfarads and feeble inductances, due to the coils of the circuit, the sound obtained is very shrill, and the intensity of the alternating current may attain 20 or 25 effective amperes in the condenser circuit. Under these conditions, P. Janet measures with a thermal ammeter the current intensity, I, in the derived circuit, and with a thermal voltmeter the difference of potential, e, at the ends of the coil. Then, neglecting the resistance of the coil and the inductance of the rest of the circuit, we have

$$I = \frac{e}{L\omega}$$

And further, $\omega = \frac{2\pi}{T}$; and hence $L = \frac{e^2 C}{I^2}$

The last formula permits the calculation of L by purely electrical methods, and without any acoustic measurements.—P. Janet, Comptes Rendus, February 24, 1902.

SOME ELECTRICAL DEVELOPMENTS.

IN the fourth of his course of lectures at the Royal Institution, Lord Rayleigh began by explaining how Weber's hypothesis that the molecules of a piece of iron are already magnetized, but are lying about in all directions indifferently, and so do not produce any magnetic effect as a whole, is in close agreement with all the observed phenomena. Prof. Ewing has illustrated this by a model which shows clearly why magnetism is not proportional to the magnetizing force, and how the friction of the molecules causes magnetic hysteresis. Some pretty experiments, due to Prof. Elihu Thomson, were shown to illustrate electro-magnetic induction through space. When a coil of wire with its ends attached to a miniature lamp was brought near an electro-magnet, the lamp lit up. Inserting a plate of glass between the magnet and the coil had no effect, but a thick sheet of copper screened off most of the magnetism and caused the lamp to burn dimly. When a ring of aluminium was placed over the magnet and the current turned on, the ring was repelled several feet high by the magnetic repulsion. The lecturer next considered the mechanical

effects of electrical currents, and stated that the general tendency of the mechanical forces is to make the self-induction circuit a maximum. This theorem, which, we believe is due to Lord Rayleigh himself, is little known among electrical engineers, but is a most valuable one, as by its means all the various attractions and repulsions of electric currents are reduced to one law. Barlow's wheel was exhibited—the principle of which is used in all electric meters which have a disk rotating on mercury—and its action explained by the attempt of the circuit to assume a state of maximum self-induction. He mentioned also how the method is used in Lorentz's apparatus for determining the unit of electrical resistance in absolute measure, and referred to his own experiments to determine this twenty years ago. Prof. Viriamu Jones' modification of this apparatus has been set up at Bushy House, and it was intended to make further experiments by this method. Lord Rayleigh suggested that it would be useful in measuring the very small resistances which shunt ammeters for reading very high currents. We fail, however, to see how it could be applied for this purpose, as, even if possible, it would be exceedingly difficult to eliminate the resistances of the points of contact. In conclusion the lecturer praised the Kelvin balance, and stated that he was doubtful about the permanency of the magnetism in the Weston instruments.

THE CHEMICAL CHANGES IN THE RIPENING OF CHEESE.*

By WALTER F. SUTHERST, PH.D., A.I.C.

CHEESE is that portion of milk coagulated by rennet which has undergone more or less decomposition by the combined action of microbes and ferments.

According to the latest investigations, milk consists of water, fat, milk sugar, casein, lactalbumin, lactoglobulin, and mineral matter, this last composed largely of calcium phosphate. When rennet is added to milk the casein undergoes a change, one portion being precipitated and another remaining dissolved. The name given by Hammarsten to the first is paracasein, to the second whey-protein. This paracasein, with the fat and lactoglobulin which are held in the precipitated mass, together with a small amount of milk sugar, constitute the curd or basis of cheese; in the serum or whey remain the whey-protein, lactalbumin, and some of the milk sugar and salts. Since the curd has practically the same composition, no matter from what animal the milk is derived, or at all events contains the same constituents, the question might easily arise, "How is it possible that from the same basis a number of varieties of cheese can be produced?" It is evident, then, that, during the after-treatment of the curd, some particular flavor-giving microbe is more favored than others, and by its peculiar action, the taste and appearance of the particular cheese is obtained.

The freshly prepared curd is opaque, practically tasteless, insoluble in water, and whitish in appearance; while the ripe cheese is semi-transparent, has usually a strong taste and smell, is partly soluble in water, and yellow in color. The cheese has undergone some fundamental change, and the passage of the fresh curd to the finished cheese is called the ripening process.

A final explanation of the ripening process is still wanting. Two agencies appear to be the chief causes of the ripening, viz., microbes and enzymes. Of these, the microbic action is the most varied, and on it probably depends the peculiar tastes of different cheeses. In cheese ripening, the lactic acid bacilli, the cause of sour milk, play a part, but more important than these are the digestive or peptonizing bacteria, which act on the nitrogenous substances of the milk, like the digestive enzyme pepsin. This class has been investigated thoroughly by Duclaux, who isolated them from Cantal cheese, and gave them the general name of tyrothrix. According to him these were the most active agents in breaking up the paracasein. A new phase of the study of the causes of cheese ripening was opened up by the discovery, in 1897, by Babcock and Russell, of an inherent milk ferment, which possesses the property of digesting paracasein without the aid of micro-organisms. This ferment, which they named galactase, shows strong resemblance to the pancreatic enzyme trypsin, as well as to the digestive bacteria usually found in cheese, so that these widely different agents together produce the same result. It has been suggested by Duclaux that a ferment similar to galactase, which he called casease, was present in cheese, but that it was of bacterial origin, being produced by a variety of the tyrothrix group. Babcock and Russell, however, proved that the new ferment was not produced by bacteria, and that, moreover, cheese could be ripened by its action alone, without the aid of micro-organisms. They succeeded in ripening, in chloroform, a cheese previously treated with galactase. That the micro-organisms take no part in the actual ripening process is, of course, absurd; and it must be admitted that, although certain substances exist naturally in milk, which are capable of peptonizing the casein, it is the combined action of microbes, ferments, and light which bring about this change. It may happen that most of the peptonizing action can be brought about by galactase alone, e. g., when the digestive bacteria are not present in large quantities; Frendenreich recently found that ordinary Swiss cheese did not contain many digestive microbes, their growth being retarded by the enormous quantities of lactic acid bacilli present.

Another agent in the ripening process, especially in soft cheeses, is the mold. Johan-Olsen, who has paid particular attention to these, finds that they are capable of ripening cheese alone, and he succeeded in obtaining good qualities of Gorgonzola and Roquefort by inoculating sterilized curd with various pure cultures of molds obtained from these kinds. The molds or fungi need air for their growth and find a favorable medium in the soft cheeses, which are not pressed and are often made flat so as to allow the air to act over a large surface. The quantity of lactic acid in these unpressed cheeses greatly assists the rapid growth of the molds. The most important function of these fungi is the oxidation of the lactic acid or carbonic acid and water, thus destroying the activity and giving more scope to the digestive bacteria.

It is the micro-organisms, present naturally in, or intentionally introduced into, the curd which determine the numerous varieties of cheeses. Every variety of cheese has its special bacteria and can be prepared by isolating certain dominant bacteria and placing them in the milk before renneting and then allowing to ripen under the conditions peculiar to the variety.

In the ripening the first constituent of the curd attacked is the milk sugar. The lactic acid bacilli begin as soon as the curd is molded, and in a few hours completely transform the sugar into lactic acid, which remains as such during the rest of the time, excepting a portion which is neutralized by the ammonia formed. The amount of acidity at this stage has much influence on the final quality of the cheese.

There is very little change in the nitrogenous matter of the curd until the lactic acid fermentation is over, when by the united action of the agents already mentioned, it splits up into crystalline substances soluble in water. Duclaux was the first to isolate the various substances formed, and he showed that first of all an albumose intermediate between the paracasein and peptones—which he named caseone—was formed: this is next split up into peptones, which are later changed into crystallizable bodies, chiefly amido-acids from which lencine, tyrosine, glutaminic acid, diaminoacetic acid, phenylamido-propionic acid have been isolated. The final product of decomposition is ammonia, which is easily detected in ripe cheese. The milk fat does not change perceptibly, but it is supposed that a partial saponification takes place, by which fatty acids, especially butyric, and glycerin are set free. Although glycerin has never been isolated in cheese, still a larger amount of volatile free acids are found in cheese than in milk. These acids must have come chiefly from the butter fat present, though it is possible for butyric acid to be formed by fermentation from lactic acid. One hears occasionally that the total amount of fat is greater in the cheese than in the fresh curd, and the reason generally given is that fat is one of the decomposition products of the albuminoids. But although some fatty acids are formed by the decomposition of paracasein, it is hardly possible for true fats to be formed. It is probable that an error in the analysis gave too high figures, and the ether used in the fat estimation also dissolved some substances other than fat.

Whether the mineral constituents of cheese undergo any radical change during the ripening or not, is not known, and it is evident that their action would be very limited, and only of use during renneting.

The best explanation of the changes which the constituents of cheese undergo during ripening is by comparing the composition of fresh curd with that of ripe cheese. With this object in view a cheese was prepared for me at the Dairy Institute, Worleston, and from this samples were taken from time to time and analyzed at the laboratories of the Agricultural College, Holmes Chapel.

The methods employed in the analysis were those suggested by Stutzer (Zeitschr. Analyt. Chem. 1896, p. 493), as follows: The ash was determined by incinerating 10 grammes of the cheese in a platinum dish over the free flame till constant weight. For the remaining constituents Stutzer recommends grinding up the cheese with pure sand, so that a homogeneous sample can be taken. Moreover, the finely divided state of the cheese allows of its being more easily acted upon by the various reagents. I then mixed intimately 50 grammes of cheese with 200 grammes of washed and ignited sand, and from this portions were taken for the various estimations.

The water was found by heating 15 grammes of the sand mixture in a water oven till constant weight.

The dried residue from the water estimation was then extracted with anhydrous ether in a Soxhlet's apparatus, and the fat dried at 105 deg. C. and weighed.

The lactic acid was determined by macerating 15 grammes with cold water and filtering, and titrating the filtrate with N/10 NaOH.

The total nitrogen was found by Kjeldahl's method, using 10 grammes, the oxidation being carried out with a mixture of 100 parts of conc. sulphuric acid and 20 parts of phosphoric anhydride, together with a little mercury.

For the separation of the nitrogenous decomposition products, several methods have been suggested, none, however, based on purely chemical lines, owing to the lack of knowledge of the albuminoids, and each one merely consists in precipitating them in groups and estimating the total nitrogen in each. There are methods for isolating a few of these compounds, but till they can all be completely separated it is as well to leave them in their respective groups. The general scheme of separation is as follows: The paracasein being insoluble in water, and the albumen rendered insoluble by boiling water, to remove these the cheese is treated first with boiling water and filtered. In the filtrate are the remaining nitrogen compounds, the albumoses, peptones, amido acids, ammonia, etc. Although the albumose and peptones dissolve in water, they are easily rendered insoluble by the addition of various substances, among which tannic acid, phospho-molybdic acid, phospho-tungstic acid, trichloracetic acid, have been tried with success. In the precipitate obtained in this way the nitrogen is estimated. The filtrate from this group contains the amido acids and ammonia compounds, and in this the total nitrogen is determined, and the amount found for ammonia deducted from this.

I used a solution of 120 grammes sodium phosphate, 200 grammes sodium tungstate, 100 c. c. dilute sulphuric acid (1 : 3) in one liter of water, being the one recommended by Stutzer and others. The nitrogen existing as albumose and peptones was determined by mixing 20 grammes of the sand mixture with 100 c. c. water, boiling in a porcelain dish for half an hour, and pouring off the supernatant liquid into a 500 c. c. flask, the same process being repeated with the same amount of water till 500 c. c. of liquid was obtained. After cooling, the flask was filled up to the mark, filtered, 200 c. c. of the filtrate taken, and, after adding an equal volume of dilute sulphuric acid, precipitated with 50 c. c. of the phospho-tungstic acid solution. The liquid was then filtered, the residue well washed with dilute sulphuric acid, and then estimated for nitrogen by Kjeldahl's method.

The amido-nitrogen could of course be estimated in the filtrate from the last experiment, but a safer way is as follows: 20 grammes were mixed with 150 c. c. water and well shaken in a bottle for 15 minutes, then allowed to stand for 15 hours, after which 100 c. c. dilute sulphuric acid were added, then 50 c. c. phospho-tungstic acid solution. The mixture was filtered and washed as before, and in an aliquot part of the filtrate the nitrogen was estimated in the usual way. From the nitrogen found the quantity existing as ammonia was deducted.

The ammonia-nitrogen was determined in 20 grammes of the sand mixture by distilling with barium carbonate (other alkalies, such as magnesia, caustic soda, baryta, cannot be used here, since they decompose the albuminoids present, setting free ammonia), the ammonia being collected in N/10 sulphuric acid.

By subtracting the amount of nitrogen found as ammonia, amides, albumose, and peptones from the total nitrogen, the nitrogen existing as casein and albumen is obtained.

The following tables give the rate of decomposition of the various ingredients, and the various changes during the ripening process of the cheese, beginning with the fresh curd:

TABLE I.

	Date of Analysis.		
	July 10.	August 23.	October 16.
	Per cent.	Per cent.	Per cent.
Water	38.07	37.36	36.54
Acid	1.818	1.246	1.116
Fat	31.18	32.08	33.06

TABLE II.

Nitrogenous Decomposition Products as Nitrogen.

	Date of Analysis.		
	July 10.	August 23.	October 16.
	Per cent.	Per cent.	Per cent.
Total N	4.824	4.916	5.021
Casein and albumin	..	2.203	1.850
Albumose and peptones	..	1.586	1.288
Amides	..	1.120	1.848
Ammonia	..	0.007	0.025

In conclusion, I wish to express my best thanks to Miss Forster, Lady Principal of the Dairy Institute, Worleston, and Mr. F. H. Billington, one of my students, who helped me considerably in the experimental part of the work.

*Read before Society of Chemical Industry.

BESSEMER STEEL PRODUCTION IN THE UNITED STATES.

THE American Iron and Steel Association presents complete statistics, received direct from the manufacturers, of the production of Bessemer steel ingots and castings in the United States in 1901; also of the production of Bessemer steel rails by the producers of Bessemer steel ingots. The ingot statistics include a few thousand tons of Bessemer steel castings.

Ingots.—The total production of Bessemer steel ingots in 1901 was 8,713,302 gross tons, against 6,684,770 tons in 1900, showing an increase in 1901 of 2,028,532 tons, over 30 per cent. The production of 1901 was by far the largest in our history. The following table gives our production of Bessemer steel ingots and steel castings in the last six years, including the production of the Robert-Bessemer and Tropenas works. Of the production last year 6,764 tons were steel castings, against a similar production in 1900 of 6,467 tons. The figures are in long tons:

1896	3,919,906	1899	7,586,354
1897	5,475,315	1900	6,684,770
1898	6,609,017	1901	8,713,302

Below is given by States the production of Bessemer steel ingots in the last four years:

	1898.	1899.	1900.	1901.
Pennsylvania	3,402,254	3,968,779	3,488,731	4,293,439
Ohio	1,489,115	1,679,237	1,988,124	2,154,816
Illinois	1,105,040	1,211,246	1,115,571	1,324,217
Other States	612,608	727,092	692,344	940,830
Total	6,609,017	7,586,354	6,684,770	8,713,302

There were no Clapp-Griffiths works in operation in 1901 and only two Robert-Bessemer plants were active. Seven Tropenas plants were at work, the same number as in 1900. All the Robert-Bessemer and Tropenas plants were employed in the production of steel castings.

Rails.—The production of all kinds of Bessemer steel rails by the producers of Bessemer steel ingots in 1901 was 2,836,273 gross tons, against a similar production in 1900 of 2,361,921 tons and 2,240,767 tons in 1899. The maximum production of Bessemer steel rails by the producers of Bessemer steel ingots was reached in 1901. The year of next largest production was 1900, which was closely followed by its predecessor, 1899. In 1887, fourteen years ago, 2,044,819 tons were made. This was the fourth year of largest production. The following table shows the production by States of Bessemer steel rails by the producers of Bessemer steel ingots in the last four years. The figures given do not include a small quantity of rails made each year from purchased blooms or from rerolled steel rails, statistics for both of which products for 1901 are not yet available.

	1898.	1899.	1900.	1901.
Pennsylvania	1,052,771	1,224,807	1,195,355	1,406,008
Other States	902,656	1,015,960	1,166,666	1,430,275
Total	1,955,427	2,240,767	2,361,921	2,836,273

At the request of the manufacturers the Association reported for 1897, for the first time, the production of Bessemer steel rails weighing 45 pounds and less

than 85 pounds to the yard from those weighing less than 45 pounds and over 85 pounds. This separation is continued for 1901, as follows:

	Under 45 pounds.	45 pounds and less than 85.	85 pounds and over.	Total.
Pennsylvania.....	30,001	1,005,979	230,728	1,466,008
Other States.....	90,213	1,106,958	263,094	1,430,265
Total, 1901.....	140,214	2,232,237	493,822	2,836,273
Total, 1900.....	154,796	1,995,067	602,058	2,361,921

It will be noticed that there was a considerable decline in 1901 in the production of steel rails weighing 85 pounds and over as compared with 1900. This is somewhat of a surprise.

The total production of rails in 1901 will include rails made from open-hearth steel and iron rails. When all the figures are collected it will probably be found that our total production of all kinds of rails in 1901 was about 2,875,000 tons.

Great Britain's largest annual production of Bessemer steel rails was in 1882, when she made 1,125,785 tons. In 1901 we more than doubled her best year's work.

A REMARKABLE SLAB OF FOSSIL CRINOIDS.*

By E. O. HOVEY.

IN November, 1901, the Department of Geology and Invertebrate Palæontology of the American Museum of Natural History received from Frank Springer, Esq., of East Las Vegas, New Mexico, the gift of a large slab of the fossil crinoid which is known to science as *Uintacrinus socialis* Grinnell. This crinoid is characteristic of the Niobrara Chalk horizon of the Upper Cretaceous of western Kansas. This slab, which is five feet four inches long and three feet two inches wide, in extreme dimensions, has been mounted and is now on exhibition in the Geological Hall, on the fourth floor of the Museum.

Crinoids belong to the same great subdivision of the animal kingdom as the common modern starfish, but they are of a lower grade of organization. Some forms are provided throughout life with stalks, or stems, the lower ends of which are rooted in the mud of the sea-bottom or attached to some foreign object. Other forms, like the Comatula of the present seas, had such stalks during the very early stages of their existence, but lost them afterward, and floated free in the water. Crinoids seem to have been most abundant, both in species and in individuals, during Lower Carboniferous (late Palæozoic) time, but, for the most part at least, they were stalked forms, leading a stationary existence. The free forms were more abundant later and now are very numerous, more than two hundred species of the family Comatulidæ having been described from the present ocean. *Uintacrinus* was a free form and has been found only in beds of Upper Cretaceous age.

The first specimen of the genus was found in 1870 by Prof. O. C. Marsh in the Uintah Mountains in northeastern Utah. The Kansas specimens have added very greatly to our knowledge of these beautiful animals and have given Mr. Springer the material from which he has been able to complete the morphological studies of the genus made by Mr. F. A. Bather of the British Museum on European material. Mr. Springer's conclusions have been published in an elaborate memoir by the Museum of Comparative Zoölogy of Harvard University with several plates.

The investigations of Mr. Springer and others at the best localities show that these crinoids lived in populous colonies in the quiet mediterranean sea or lagoon which occupied western Kansas in Cretaceous times. Those crinoids that were at the lowest part of the floating mass rested directly upon the soft mud and settled into it in the positions in which they happened to be when the colony died. These were thus perfectly embedded by the lower side in a fine matrix which preserved them like a mould. The other individuals of the colony settled down on top of these and, not having a soft or plastic bed to receive and preserve them, were crushed out of shape and disarticulated, and their component plates were indiscriminately mixed up. The whole mass was cemented together under pressure, forming a slab—a thin layer of limestone as we now find it—with the crinoid bodies preserved only on its lower side. The largest of these lenticular layers of limestone was about fifty feet long and twenty feet wide with a thickness of half an inch in the middle, thinning out on all sides to the thinness of cardboard. More than twelve hundred specimens in which more or less of a calyx was shown were obtained from this deposit. The arms of these crinoids are so mingled in the slab that it was impossible to free any of them, but some of them have been traced to a distance of forty inches from the body to which they belong.

The slab which the Museum has received from Mr. Springer shows distinctly at least sixty-five bodies, while fifteen or sixteen more can be made out under the covering of entangled arms. The body or calyx had thin walls, the plates of which were apparently connected by a sort of articulation or loose suture, so that it was more or less flexible and comparatively light in weight. All the calices have been flattened so that the opposite walls have been brought together in the form of a watch crystal.

* From the American Museum Journal.

UINTACRINUS SOCIALIS—Grinnell. AN INDIVIDUAL FROM THE SLAB. NATURAL SIZE.

UINTACRINUS SOCIALIS—Grinnell. FOSSIL CRINOID FROM KANSAS.

Mixed Birdseed.—

Canary seed	6 parts.
Rape seed	2 parts.
Maw seed	1 part.
Millet seed	2 parts.

—Pract. Drug.

EFFECT OF GEOGRAPHICAL CONDITIONS OF AUSTRALIA UPON ECONOMIC CONDITIONS, ETC.

IN a paper read before the Geographical Society of Paris, M. Vigoroux showed the influence which the geographical conditions of Australia had upon the economic as well as political and social organization of the country. As to structure, it is that of an immense plateau, with a granitic base, and this configuration explains the absence of any important river systems. On the west side the forests extend to 250 or 300 miles from the coast; the trees have an abundant growth, and the Eucalyptus is one of the most common varieties. Specimens of this tree have been met with which reached more than 300 feet in height and whose hollow trunk could afford space for a horse and rider. The kangaroo and wild dog are the animals most frequently met with. In the west are immense pasture lands, and in the central part extends a series of salt lakes which forms a kind of interior sea. In the north the lack of water has led to the extensive use of artesian wells. The conditions of the Australian continent may be considered as favorable for stock-raising, but unfavorable for agriculture, and it is not likely that its agricultural products will enter into competition with those of Europe. The geographical situation of Australia has brought about certain economical consequences, and the principal one has been that of occupying immense surfaces of territory for stock-raising, which requires a great space but needs little hand labor, while agriculture occupies a great number of persons upon a small area. The pasturage industry has become well developed, as is shown by the figures for 1892, giving a total of 84,307 persons employed in the industry. At present the territory occupied for stock-raising equals 875,000,000 acres, while agriculture takes only 7,000,000 acres. The pasturage products figure double the value of the agricultural. The author brings out the effect of the geographical situation upon the political and social conditions, and shows that the penetration of the Australian continent could not, like that of North America, be brought about by means of the great rivers and lakes, in starting from the already peopled centers as a base. Besides, the best ports were separated from each other by a considerable distance, and also by natural obstacles, such as mountains or deserts. Thus it was brought about that around the ports were formed five distinct colonies, which afterward grew into federations. The author considers the effect of the local conditions, and especially the climate, upon the labor question in Australia. It is due to the climate for the most part that the eight-hour day system has been generally adopted; again, the mild climate enables outside work to be carried out all the year round, and so the workmen arrive at the same total production in spite of the reduced hours of work. On the other hand, during the

summer heat, it becomes more difficult to keep up a continuous effort, and this has caused a difference in the habits of Australian and European Anglo-Saxons. In the tropical region the white race cannot work for a long period without giving away, and this has made it necessary to employ Polynesian and Asiatic labor. This will no doubt bring about a race struggle, and in fact it has already given rise to certain economic and social problems which are now absorbing the attention of the Federal Parliament.

ORIGIN AND USE OF IVORY.

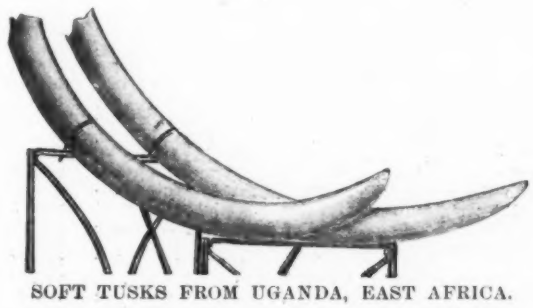
THE working of ivory dates back to the earliest epochs of history. The old Egyptians made dainty articles of art and useful objects from the costly material, which are still to be found in many museums. Phidias, the Hellenic master, is said to have fashioned of ivory his large Zeus, whose garments were of gold. With the Romans, ivory was, especially during the imperial period, most extensively employed for various articles of luxury. During the Middle Ages, monks employed ivory for book covers, boxes for relics and jewels, etc. Ivory reached the highest triumphs, however, only when the genius of Michelangelo was bent to the use of this product, which was for a long time esteemed as highly as gold. The Japanese or Chinese knicknacks, the dainty Oriental, mostly Indian, chessmen have for centuries been made preferably of ivory. In Europe the changing fashion has almost entirely crowded out ivory from the list of the materials suitable for the construction of objects of art. To-day it is almost exclusively used for articles, such as piano keys and fan sticks, which are poetical enough compared with the prosaic billiard-ball, cane and umbrella handles, flute heads, knife handles and combs. If the tusk of the largest pachyderm has lost a field of usefulness, the requirements of raw material still remain considerable. On an average 838,000 kilos of ivory are annually used. Of this amount, 123,000 kilos fall to India and 19,000 kilos to China. To supply these quantities, which represent a value of about 17,000,000 marks (over $4,000,000), about 65,000 elephants have to yield their lives.

In India, the home of the Indian elephant, who externally can be distinguished from his African cousin only by the smaller ears, wild elephants, according to reliable reports, were once so numerous that it was necessary to resort to poison to protect the plantations from their devastations. To-day they have been almost entirely exterminated from South India, and even in Ceylon old males with tusks are rare. The entire ivory production of India, therefore, amounts to scarcely 7,000 kilos per year, which is shipped via Calcutta mostly to Bombay and the Chinese ports. The balance of the demand is supplied by the African elephant.

Spread over almost the whole of Central Africa, wherever there are plants and water, the gregarious animal lives in herds or troops. The more favorable the conditions of existence and the more tropical the climate, the better developed are his tusks. Thus the ivory found in the immediate vicinity of the equator is the finest and most vitreous, while that coming from the extreme northern and southern limits of the elephant territory is the coarsest and cheapest. The handsomest tusks are found north of the Ukerewe Lake up to Abyssinia. The authentically longest tusk was bought at Tabora in 1886 by a well-known Hamburg ivory firm. The tusk in question came from the district of the Tanganyika Lake in Central Africa and measures 2.94 meters. Full-grown tusks of old males are mostly 2 meters, rarely 2½ meters, in length, with a weight of 30 to 90 kilos, although now and then such weighing 150 kilos are said to occur. The handsomest teeth are hard to get, because they are much sought after as decorations for dwellings, tombs and temples; but once in a while it happens that such a rarity can be acquired, though, it is true, only with great trouble and at much expense. The firm mentioned possesses the largest and longest pair of elephant tusks that have ever reached Europe. (See illustration.) The tusks, of faultless quality, weigh 101 kilos and measure 2.57 meters each; they came from Uganda, and have a commercial value of 3,775 marks ($900).

There are two kinds of ivory, viz., the hard and the soft variety. The hard kind, also called live or glass ivory, is the least esteemed and is exported exclusively from the western coast of Africa. The soft grade, also termed dead or genuine ivory, comes chiefly from Zanzibar and the east of Africa. From the latter, keyboards, billiard-balls, and combs are made, while the hard kind is used for the manufacture of all those articles where a uniformity of the veining is of less importance. The price of ivory fluctuates considerably and is now rising, since the supply of the necessary quantity is causing more and more difficulty. Of late endeavors have been made—especially in the German possessions in Africa—to put a stop to the killing of the valuable pachydermata by rigid laws; this is an urgent necessity, since otherwise the elephant will have entirely disappeared in a few decades, as he is getting exceedingly rare already. Major von Wissmann, the courageous German pioneer of civilization in the dark continent, himself an able huntsman, has contributed his share in urging the most far-reaching measures for protecting the elephant from extinction.—For our illustrations and the accompanying cuts we are indebted to Fuer Alle Welt.

IVORY CARAVAN.



SOFT TUSKS FROM UGANDA, EAST AFRICA.

ANCIENT MONUMENTS IN MODERN ITALY.*

ART and archæology do not often come into Royal Addresses, but such an innovation in government procedure occurs in the Speech from the Throne of the young King of Italy, delivered at the opening of the Legislature in Rome last week.

Among the many weighty affairs of State proposed to be discussed during the forthcoming session of the Italian Parliament—weighty with the responsibilities of reviving enterprise, flourishing finance, and the general prosperity of the country—space is found for Roman improvements, further extensive alterations at Naples, and (what is of greater interest to the general educated public) a development of the conservative principles affecting public monuments which have become so remarkable during the last few years in Italy. The King intimates in his speech that the whole peninsula is to be brought under the government organization already established for preserving works of artistic and historical interest, which at present seems to be confined to the more northern provinces. This admirable institution of recent years, although not the only body representing a national interest in the preservation of antiquities, is the responsible government authority in such matters, wherever it has been inaugurated, and it influences and controls to some extent the less important local societies. In Italy these local societies, although founded for the purpose of popularizing the study and care of national history, are frequently swayed by local interests, and even, strange as it may seem, by political considerations, and occasionally their influence is anything but conservative. In the case of a country such as Italy, many parts of which are still in a comparatively barbarous state, and where a very superficial education in the richer classes of the community is just sufficient to induce a desire for what is called "restoration" or renovation of the public monuments, such an institution as the "Ufficio per la Conservazione dei Monumenti" is evidently of immense value.

Forty years ago, in the days of the "Unification" of Italy, laws for the preservation of national monuments were perhaps of greater necessity than even at present. The mutilation of statues and other monuments in public places, which expressed the political changes in a particularly brutal manner, would hardly be permitted at the present day on the score of the

* The Builder.

THE LONGEST TUSK, FROM TABORA, EAST AFRICA.

THE LARGEST AND THICKEST PAIR OF TUSKS.

commonest public decency. Not merely the erasure of historic inscriptions referring to bygone institutions, but often the most disgraceful vulgarity was perpetrated, such as the conversion of a bronze colossal statue of one of the popes into a patron saint of the town, at Rimini, by the substitution of a rudely-formed episcopal miter in place of the tiara, with a clumsy representation of a crozier in one hand, the whole transformation the work of some common blacksmith, who must have been employed by the baser part of the community thus to disfigure the town. Numerous were the instances in those days of such malpractices, committed by municipal and other authorities for the purposes of currying favor with an uneducated democracy, and eager to commemorate their terms of office by some unnecessary change in the aspect of the towns they had to do with.

At the present moment a certain class of ancient monuments is attracting a great deal of attention in Italy. The ancient town-walls have been hitherto retained in a remarkable degree of completeness, partly on account of the manifest uselessness of pulling them down, and partly—or, perhaps, chiefly—because they happened to remain in use as octroi boundaries, long after their original intention as fortifications had disappeared. Hitherto these ancient walls have formed one of the most characteristic and picturesque features connected with the old Italian cities, and their gradual disappearance will detract materially from the old-world charm of the peninsula. In some of the cities a vigorous effort is being made for their preservation, but it can hardly be expected that mere sentimental reasons for their retention can weigh against the speculative money-making interests involved in the conversion of their sites to other purposes. Rome still retains its ancient wall, of untold associations, almost complete. Florence lost hers in 1860-1870, when the octroi boundary was pushed much farther out into the country; Milan retains the greater portion of its sixteenth century fortifications, crowned with beautiful horse-chestnuts, and affording the pleasantest of promenades.

The citizens of Bologna and Genoa are now deciding to remove these boundaries of their past history, in spite of a determined protest in each case on the part of certain dissentients who find a great deal to say on the subject in the local daily journals. In the case of Bologna a great deal may be urged against the destruction of the wall. It is quite unnecessary on the score of enlarging the city, as there are large tracts of unoccupied ground still within it. The only excuse for its removal which can be urged by the party of destruction, is that the city will thereby be modernized. In other words, the object in view is to do away with one of the special features which render an old Italian town different from anything of the kind to be found in other countries. This must, of course, in time, seriously affect that large section of the townspeople which lives on profits derived from the tourists and visitors, whose only attraction to such a place as Bologna is its old-world character. But the misdirected ambitions and the ceaseless modern craving for something new, which have affected Italian municipalities ever since 1870, are now inducing the Bolognese to this stupidity, to be regretted by every one except the contractors secure of an immediate profit out of the job, and the town councilors who vainly imagine that their interests and their popularity may be increased thereby. At a recent meeting of the town council it was decided to carry out this piece of destruction, in defiance of the efforts of the conservative party, headed by Signor Rubbiani. The deed may, however, be still averted through the action of the Department for Preserving National Monuments, and it is in such cases as this that fuller and more adequate powers seem to be required by the government for dealing with the historical memorials of the country, as referred to in the King's recent speech.

Genoa does not depend for its interest to the passing visitor so much on historical memorials as Bologna. The mediæval aspect of the city, which is so striking and complete in the case of Bologna, is absent in the great maritime city. Genoa lost its mediæval walls ages ago, and the fortifications which are to be demolished are comparatively modern, although long out of date, as such things go. Genoa, while losing a great deal of its old-world imposing character, with the massive stone-sheathed earthworks of the seventeenth century, will always remain one of the most beautiful of cities, occupying one of the most striking sites in the world. Bologna, on the contrary, deprived of its mediæval character, would not attract a single visitor of the thousands who annually stay over a few nights, to explore its endless arcaded streets within the ancient brick wall which has protected them for so many centuries from the bitter "tramontana" wind sweeping over the ugly flat Lombard plain.

THE CONCENTRATION OF WINE.

THIRTY years ago, after the close of the Franco-Prussian war, Commander Morlière, a French artillery officer, induced his friend Dr. F. Garrigon to experiment with concentrated food and drink in his laboratory. Dr. Garrigon at once began to devote all the time that could be spared from his researches upon mineral waters to experiments upon this subject, and, urged on by the commissary department, as well as by numerous officers of all grades, endeavored to solve, before all other problems connected with the study, that of the concentration of wine, milk, bouillon and other liquids of prime importance to armies in the field.

Commissaries-General Viguié and Rossignal said to him: "Should you succeed in conceptrating wine only a half, it would prove an immense service both to an army on a campaign and to viticulture."

Encouraged on all sides, he in 1877 finished all the fundamental experiments in concentrating liquids for army use.

Before explaining what must be understood by the concentration of wine, let us quote what Dr. Garrigon has to say about wine itself:

"Wine is a liquid derived from the expression of fresh grapes, and accompanied, in a state of solution, with the organic and mineral substances that the roots of the vine have extracted from the soil, as well as a special ferment, which, under certain conditions of temperature, splits up the natural sugar of the fruit into alcohol and carbonic acid, permitting likewise the development of acid products and ethers that give wine its tartness and bouquet."

The concentration of wine consists in removing from this liquid a greater or less quantity of its natural water, while at the same time allowing it to preserve, unaltered, all the other substances of which it is composed. The water can be removed in two different ways: (1) By employing the improved Bourguignon process which consists in freezing the liquid, and then removing the water in the state of ice; and (2) by concentration through heat in a vacuum. The first of these processes has not yet entered the domain of practice, and is still the object of Dr. Garrigon's studies.

The process of concentration by heat is much more advanced, and, since it has already entered the domain of science and seems likely soon to enter that of industry, we shall have a few words to say about it. The concentration of wine presents two difficulties, the prevention of a disagreeable taste due to heat, and that of the loss of alcohol and bouquet.

In evaporating wine in a vacuum its point of ebullition is lowered to such a degree that it is impossible for it to acquire a burnt flavor, which is produced at a temperature bordering upon 70 deg. C.

As for the preservation of the alcohol and bouquet, that is likewise very simple. All that has to be done is to cool the vessels in which the concentration of the distilled vapor is effected to —20 deg.

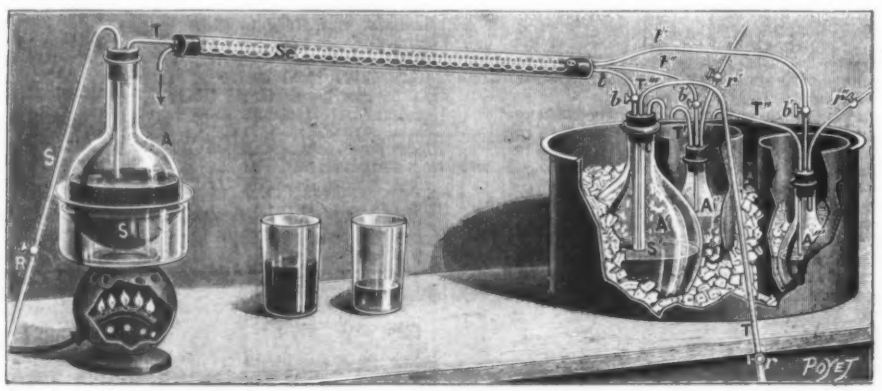
The apparatus invented and patented by Dr. Garrigon for the concentration of wine consists of a retort, *A*, placed in a water bath, *S*. From the bottom a glass siphon leads up through the stopper of the retort, the tube being provided at *R* with a cock. From the top of the retort starts a tube, *T*, that connects with a worm, *Sc*. At *r'* is a cock to permit of the entrance of air into the apparatus.

The extremity of the worm terminates in a stopper whence start the tubes, *t t' t''*, which descend to the bottom of the tin-lined copper vessels, *A' A'' A'''*, provided with cocks, *b b' b''*. At the upper part of each of these vessels there is a cock, *r r' r''*, for the admission of atmospheric air. Upon the tubes, *t t' t''*, there is a cock to permit of interrupting or re-establishing communication with the rest of the apparatus. From the top of the vessels, *A' A'' A'''*, start tubes *T' T'' T'''*, that put the vessels in communication with a vacuum pump. Vacuum gages, *Ca C'a C''a*, are secured to each of the vessels, *A' A'' A'''*.

The operation of the apparatus is as follows: A vacuum is first formed by means of the pump, and then the quantity of wine that it is desired to treat is introduced into the retort, *A*, through the siphon, *S'*. Then the water bath and afterward the wine is heated. The latter enters into ebullition at a very low temperature, say, of about 25 deg. or 28 deg. C. The ethers and a certain quantity of alcohol become volatilized and are concentrated first in the vessel, *A'*, and then in *A''*, both of which are surrounded with a —20 deg. refrigerating mixture. After this, the ethylic alcohol, accompanied with a small amount of heavier cohol, passes and continues to condense, along with a certain quantity of water, in the vessel, *A''*. After about a third of the liquid has evaporated the temperature rises to from 50 deg. to 55 deg. in the vinous extract of the vessel, *A*, and nothing thereafter comes over but alcohol of the last run and nearly pure water. This is received in the vessel, *A'''*, which is cooled simply by a current of water. After the entire quantity of water necessary for obtaining the degree of concentration desired has been thus removed from the vessel, *A*, the operation is arrested and the water bath is cooled by a current of water, and air is allowed to enter the entire apparatus. The siphon primes itself automatically, and, through it, is drawn off all the concentrated liquid contained in the retort. The liquids of the vessels, *A'* and *A''*, are poured into the extract collected, and we thus obtain wine concentrated to the degree desired. The actual cost of obtaining it is two-fifths of a cent a gallon.

Such wine is so well pasteurized that it no longer undergoes any alteration through the action of microorganisms, even when the vessels containing it are left on tap. If it be desired to bring the wine thus concentrated to its original volume all that has to be done is to add to it a quantity of distilled water, or water freed from microbes by boiling, equal to that removed from it by concentration.

For the above particulars and the engraving we are indebted to La Nature.



APPARATUS FOR THE CONCENTRATION OF WINE.

TRADE NOTES AND RECIPES.

Hektograph Pad.—The "pad," known as a hektograph, used in duplicating letters, is essentially a mixture of glue (gelatin) and glycerin. This mixture has the property of remaining soft yet firm for a long time and of absorbing and holding certain coloring matters in such a way as to give them up slowly or in layers, so to speak, on pressure.

Such a pad may be made by melting together 1 part of glue, 2 of water and 4 of glycerin (all by weight, of course), evaporating some of the water and tempering the mixture with more glue or glycerin if the season or climate require. The mass when of proper consistency, which can be ascertained by cooling a small portion, is poured into a shallow pan and allowed to set. Clean glue must be used or the mixture strained; and air bubbles should be removed by skimming the surface with a piece of cardboard or similar appliance.

Variations of this formula have been proposed, some of which are appended:

I.	
Glycerin	12 ounces.
Gelatin	2 ounces.
Water	7½ ounces.
Sugar	2 ounces.

II.	
Water	10 ounces.
Dextrin	1½ ounces.
Sugar	2 ounces.
Gelatin	15 ounces.
Glycerin	15 ounces.
Zinc oxide	1½ ounces.

III.	
Gelatin	10 ounces.
Water	40 ounces.
Glycerin	120 ounces.
Barium sulphate	8 ounces.

IV.	
Gelatin	12 ounces.
Dextrin	10 ounces.
Glycerin	100 ounces.
Barium sulphate	8 ounces.

V.	
Gelatin	10 ounces.
Water	37 ounces.
Glycerin	38 ounces.
Kaolin	5 ounces.

The writing to be copied by means of the hektograph is done on good paper with anilin ink, prepared by the following formula or one similar:

Methyl violet	½ ounce.
Alcohol	½ ounce.
Sugar	¼ ounce.
Glycerin	1 ounce.
Water	6 ounces.

Dissolve the violet in the alcohol mixed with the glycerin; dissolve the sugar in the water; and mix both solutions.

The writing is allowed to dry without blotting. The pad having been moistened with clean water, the paper is placed on it, face inward, of course, and rubbed gently but firmly over every portion, care being taken to prevent its changing position. It is allowed to remain on the pad for from two to five minutes, and is then carefully removed. Copies are now taken by pressing dry paper on this surface and removing immediately. The operation should be carried out with as little interruption as possible. The New Idea states that the distinctness and sharpness of hektograph prints may be very materially heightened by wetting the paper upon which the prints are to be made with alcohol and removing the excess of alcohol by blotting paper.

After using the pad the ink should be removed from the surface immediately with a soft sponge and warm water, drying it well. It will then be ready for another operation. It may be used a great many times, if properly manipulated.

Anilin colors other than violet may be used, of course, but the latter it is said yields more copies than others that have been tried.—Drug. Circ. and Chem. Gaz.

Laundry Soap.—A good, common hard soap may be made from clean tallow or lard and caustic soda, without any very special skill in manipulation. The caustic soda indicated is a crude article which may now be obtained from wholesale druggists in quantities to suit, at a very moderate price. A lye of average strength is made by dissolving it in water in the proportion of about 2 pounds to the gallon. For the saponification of lard, a given quantity of the grease is melted at a low heat, and one-fourth its weight of the lye is then added in small portions with constant stirring; when incorporation has been thoroughly effected, another portion of lye equal to the first is added, as before, and the mixture kept at a gentle heat

until saponification appears to be complete. If the soap does not readily separate from the liquid, more lye should be added, the soap being insoluble in strong lye. When separation has occurred, pour off the lye, add water to the mass, heat until dissolved, and again separate by the use of more strong lye or a strong solution of common salt. The latter part of the process is designed to purify the soap and may be omitted where only a cruder article is required. The soap is finally remelted in a water-bath, kept at a gentle heat until as much water as possible is expelled, and then pour into frames or molds to set.—Drug. Circ. and Chem. Gaz.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Bicycles in Formosa.*—The bicycle best suited to Formosa's requirements is one that will come up to the following specifications:

Model.—While men's wheels are generally preferred, it is worth while to note that Chinese male riders do not object to a lady's wheel; in fact, many prefer it, as it is possible with the latter to wear the characteristic long coat. Therefore, if there is any advantage in price, dealers who cater to the Chinese trade will usually permit a portion of their order to be for this model wheel. This does not apply to Japanese, however, the majority of whom have adopted foreign dress and therefore desire men's wheels. The social laws of China act as a barrier to the women of that nation riding a bicycle; and in Japan, while there are no social laws that prevent it, the general feeling among women is that it would be unladylike to engage in the sport. Japan, however, is a land of social revolution, and it is not unlikely that the wheel will in time be adopted by this sex. As evidence of this, there are at present a dozen or so high-class Japanese young ladies in Tokyo who ride, and they have organized a cycling club, to the astonishment of, I might say, the whole nation; but from the comments of the Japanese press, the innovation was as a rule favorably received by the men and the use of the bicycle generally advocated. The Japanese young lady has but little of the physical strength of her Western sister, and the moderate use of the wheel would doubtless be a very beneficial form of exercise.

Size.—Japanese and Chinese, who are practically the only customers for bicycles in Formosa, will average somewhat under foreigners in height. Consequently, a 22-inch frame is the most suitable; in fact, dealers will not accept 24-inch frames.

Equipment.—The double-tube tire seems to be the only one suited to Formosa. Single tires have not given satisfaction here, for the reason that a really bad puncture can not be repaired without recourse to a repair shop, and there is, unfortunately, no such establishment in Formosa. Furthermore, owing to the tropical heat, the rubber packing in the tire valves frequently softens and renders the valve useless, and when this occurs they have sometimes to be replaced. With the ordinary single tube, the valve can not be taken out; thus the double tire is preferable on this score also. The Formosan customer looks more to the tire than to the frame, and the few high-priced wheels with single tires which have come into the island have been sold at a loss. All wheels should be equipped with brakes. A San Francisco dealer, in forwarding to the island a shipment of wheels which were to be equipped with brakes, wrote the local merchant that "as the use of brakes had been practically given up in San Francisco," he had taken the liberty of canceling that item in the order. The unfortunate Formosan dealer had to hold these wheels in stock for four months until brakes could be obtained from America and fitted on. The Formosan rider is but little concerned with the "fashion in San Francisco," and he does not consider a bicycle complete unless it is provided with a brake. Although adjustable handle bars do not permit of a very perfect adjustment of the handle-bar brake, these bars are desirable, as the rider can place the handles in the position which best suits him. If adjustable bars cannot be supplied, the turned-up handle bars, such as are used on ladies' machines, are preferable. The gear should be medium—say, seventy-three.

Price.—With a duty of 25 per cent and excessive freight rates, the so-called high-grade wheels are too expensive for this market. A good, strong wheel, with brake and double tires, selling in 2-dozen lots at say $15 to $16 a wheel would receive a warm welcome, and even at $17 or $18 there would be some demand. These need not necessarily be 1902 models; wheels of the 1900 model, and made by comparatively unknown manufacturers, would be quite as satisfactory for this market.

I would be pleased to learn of any machines that will comply with the above requirements, and will place the information received before the local dealers most interested.—James W. Davidson, Consul at Tamsui.

Proposed American Department Store at Bombay.—Now that the American manufacturer is trying to gain a fair share of trade in the world's markets, I would suggest that he give more attention to India. On this peninsula, which is about half the size of the United States, reside 300,000,000 people, or about one-fifth of all the inhabitants of the earth.

The exports of India exceed its imports. A careful examination of its foreign trade will show that, with few exceptions, India sells raw material and buys finished products, and therefore is substantially a consuming nation. During the fiscal year 1900-1901, the foreign trade of India amounted to over 20,000 lakhs of rupees, or about $692,000,000. Of this, $383,000,000 represented exports and $[illegible] imports. The lion's share, or about two-fifths of the entire trade, went to the United Kingdom. The United States was the third largest purchaser of India's exports, China occupying second place. As an exporter to India, the United States ranks near the end of the list. It is some consolation to know, however, that if all the articles imported from the United States into India—many of which lose their identity in being transshipped in Europe—were traceable, our sales would make a much better showing.

Great Britain is not increasing its trade with India, yet when one considers the number of years that it has enjoyed a substantial monopoly in this respect, one can form some idea of the important part India has taken in contributing to the wealth of the British Empire.

The continent of Asia and its islands have a population of perhaps 800,000,000 people and a trade worth probably $2,000,000,000 a year. Of this trade, the United States does not receive a fair share—less, indeed, than some nations which, to reach it, have two seas to our one to cross.

Few, if any, cities in the Orient offer better facilities for exploiting American goods than Bombay. It possesses a magnificent harbor, extensive systems of railways radiate from it, and its steamship and freight lines run to all parts of the globe. It is a great transshipping point by sea and is the national gateway to India. Bombay ranks third in the British Empire in the value of its annual export and import trade, London and Liverpool being first and second, respectively. Before the plague reduced its population, next to London it was the largest city in the empire. During the past year, its imports were valued at $120,000,000 and its exports at $112,000,000, making a total foreign trade of $232,000,000, or nearly half of that of all India.

Commerce with America is increasing. An exceedingly friendly feeling toward the United States exists among the people of India, and all things American are popular. A number of our business concerns have established agencies and branch houses here, and others are sending trained representatives into the field—a system I have strongly recommended to our exporters. Many letters of inquiry, catalogues, advertising sheets, and price lists come to this consulate. While this way of obtaining business is not overproductive, yet it shows that our people are beginning to realize the opportunities for trade in India.

The Indian native is not prevented by patriotism from buying where he can secure the best and cheapest goods—especially the cheapest. He naturally desires to examine the article he buys, and if "spot" cash is required, he in turn demands "spot" delivery.

I wish to impress upon the American manufacturer or exporter the desirability of placing his wares on actual sale in this market. Sample rooms, catalogues, price lists, employment of native agents, etc., have been, so far as my observation goes, somewhat barren of substantial results. The way to sell goods is to simply sell them, and the less complication the better. It would be hard to improve upon the method used by our large concerns. The merchant shows his goods, the buyer makes his selection, pays the price, and takes the article. That is all. What can be more simple? This method of buying and selling has succeeded well at home; why not abroad?

When credit sales, catalogues and samples, foreign museums, agencies, and other schemes are introduced, complications arise, all of which tend to increase the price to the consumer, without any additional advantage to the seller. I therefore recommend to the enterprising American exporter not wishing to assume the expense of sole representation in this market, that he associate himself with some noncompeting firm in a joint representation of their products.

In accordance with this idea is an American department store, composed of ten or twelve departments of noncompeting mercantile lines, each controlled by a submanager, sent out from the home house, and all under the supervision of a man of large local and general experience. Such a concern should be a stock company, with the stock held equally by the several houses interested and paid for in the goods represented, less a small percentage in cash, the latter to be used to defray the expenses of establishing the business. The clerical force and salesmen could be natives of the country, but other details should be purely on the American plan. The sales, both wholesale and retail, should be made on a cash basis, or its equivalent, and sufficient goods should be carried in stock to permit immediate delivery. In case of heavy orders and where time is not an important consideration, the present indent system could be used. The stock of the different lines could be increased or decreased, or new lines added, or other necessary changes made, as the business demanded or experience suggested. The various noncompeting lines that would probably prove successful are:

1. Boots and shoes.
2. Carriages, bicycles, and automobiles.
3. Hardware, shelf goods, edged tools, stoves, cooking utensils, etc.
4. Iron and steel, structural and corrugated iron, wire and safes.
5. Leather, harness, and trunks.
6. Jewelry, clocks, and watches.
7. Dry goods, piece goods, and sewing machines.
8. Furniture, including office and school fixtures.
9. Machinery, pumps, engines, agricultural tools suitable for India, arms and ammunition.
10. Electric machinery and electric supplies.
11. Groceries and provisions, canned goods, preserves, cured meats, fish and dried fruits.
12. Stationery, paper, certain lines of books, maps, typewriters, and office supplies.

Local firms dealing in these lines of American goods should be consulted and an understanding reached, so that conflict of business interests would be avoided.

Our manufacturers and exporters will at once see the many advantages of an American department store in this city. The unity of the various houses represented would give it strength and capital; the presence of thoroughly trained and reliable American representative agents, each a specialist in the line of which he is manager, studying the wants of the people and keeping their houses in touch with the market, are strong arguments in its favor. The goods being on hand, could be sold on their merits and at once delivered for cash, a feature that speaks for itself.

There is an American citizen here who has been in business in Bombay for some years as the principal of a merchant and commission house. He has so much faith in this scheme for the establishment of an American department store that he is not only desirous of giving his attention to it, but is willing to invest money in the concern.

He informs me that he is writing up the plan and will place it before American exporters.—Wm. Thos. Fee, Consul at Bombay.

How to Increase Coal Sales in Austria.—During the year 1901 there were imported at Trieste about 300,000 tons of coal, 20 per cent of which came from the United States. With the exception of one shipload, all the United States coal was imported by the Austrian Lloyd Steamship Company for its own use. I am informed that this company is so well pleased with the result of its experiment of substituting American for British coal that it has again contracted for 100,000 tons of our coal, to be delivered during 1902.

The praises of American coal sounded by the Lloyd's engineers induced a Trieste coal dealer to place with a New York firm an order for 3,000 tons of prime steam coal. When the coal arrived it was found to contain so large a percentage of screenings as to render it unsalable as standard steam coal, and the purchaser refused to accept it. The coal was finally disposed of at a considerable discount, but not until it had been offered to, and inspected by, nearly every other dealer in the city. The local representatives of the British coal interests unduly descanted on this incident, and it can not be denied that the reputation of our coal has suffered a serious backset.

That we have coal equal to the best British grades few dealers doubt; but I know that many of them would regard it as a very risky experiment to buy in the United States "sight unseen" a shipload of coal and pay cash for it. In fact, the large majority of our exporters of coal are not yet well enough known abroad to demand from foreign buyers more confidence than they are willing to extend to them. British coal is sent here on consignment. Nearly every British exporter doing business in Austria has a large depot at Trieste, in charge of a native agent, and it is probably safe to say that the most experienced coal men of this city are thus linked to British interests.

A standard grade of American steam coal was recently offered here for February or March delivery at a price 3s. (73 cents) below the present quotations of Welsh coal and found no taker; while in Italy and France, the same coals have for the past year been sold side by side at practically equal prices. I have no doubt that, were an American coal depot established here, from 200,000 to 300,000 tons of first-class American steam coal could annually be sold in southern Austria.

Mr. A. Weiler, who has opened at Trieste a general agency for the importation of American goods, with branch offices at Vienna, Prague, and Budapest, makes the following statement in a letter which he recently addressed to me upon the subject of coal shipments from the United States:

"The greater part of our customers know as yet little of the merits of American coal, and they will not order large quantities of it while British coal can be bought here at any time in parcel lots. There is only one way of introducing United States coal into Austria, viz., by the establishment of coal depots at Trieste, where consumers may inspect the article and buy the quantities desired. Such depots have the further advantage that foreign steamers calling at our port can be supplied with this fuel.

"When American coal is once well introduced and sufficiently known, there will be no difficulty in obtaining large orders. If your miners and shippers desire to conquer our market, they must offer their product for sale here and establish in our ports depots for that purpose, and if their coal can at all compete with the product of Great Britain, they will run no risk in doing so. I will add that we should be pleased to enter into correspondence with any good American coal firm disposed to profit by our suggestion and establish a coal depot at Trieste. I am well equipped for representing such a firm in this place, as well as in the various other cities in which I have branch offices, and I am able and ready to give any security or bank guaranty that may be desired."

There is also a demand here for good gas coal; and with wood selling at from $6 to $10 a ton, and an inferior grade of gas coke at $11 a ton, it ought not to be difficult to create a demand for anthracite coal. But such is the conservatism of the Austrian dealer that he will not buy abroad a commodity which, for more than half a century, has been brought to his very door, even if he can effect a large saving by doing so. He does not like to reckon with unknown quantities in his business transactions, and he seems willing to pay whatever it may cost to have business made easy or safe for him. When our colliers, like their British rivals, will sell their product to the Austrian dealer in his own market, the ascendancy of our coal in Adriatic ports will be assured.—Fredk. W. Hossfeld, Consul at Trieste.

Coffee Crop in Guatemala.—Consul-General McNally reports from Guatemala, December 11, 1901, that the coffee crop in Guatemala for this season will fall about 40 per cent short of that of last year. It is estimated that the yield will amount to 480,000 quintals (48,000,000 pounds).

* In reply to inquiries by a New York company, which has received advance co[illegible]

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The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

To Scent Advertising Matter, etc.—The simplest way of perfuming printed matter, such as calendars, cards, etc., is to stick them in strongly odorous sachet powder. Although the effect of a strong perfume is obtained thereby, there is a large loss of powder, which clings to the printed matter. Again, there are often little spots which are due to the essential oils added to the powder.

Another way of perfuming, which is used especially in France for scenting cards and firm articles, is to dip them in very strong "extraits d'odeur," leaving them therein for a few days. Then the cards are taken out and laid between filtering paper, whereupon they are pressed vigorously, which causes them not only to dry, but also to remain straight. They remain under strong pressure until completely dry.

Not all cardboard, however, can be subjected to this process, and in its choice one should consider the perfuming operation to be conducted. Nor can the cards be glazed, since spirit dissolves the glaze. It is also preferable to have lithographed text on them, since in the case of ordinary printing the letters often partly disappear or the colors are changed.

For pocket calendars, price lists and voluminous matter containing more leaves than one, another process is recommended. In a tight closet, which should be lined with tin, so that little air can enter, lath are fitted on the sides opposite each other, on which nets stretched on frames are laid. These nets cover with tissue paper, and proceed as follows: On the bottom of the closet sprinkle a strongly odorous and reperfumed powder; then cover one net with the printed matter to be perfumed and shove it to the closet on the lath. The next net again receives powder, the following one printed matter, and so on until the closet is filled. After tightly closing the doors, the whole arrangement is left to itself. This process presents another advantage in that all sorts of residues may be employed for scenting, such as the filters of the odors and infusions, residues of musk, etc. These are simply laid on the nets, and will thus impart their perfume to the printed matter.

Such a scenting powder is produced as follows:

Iris powder, finely ground	5 kilos
Residues of musk	1 kilo
Ylang-ylang oil	10 grammes
Bergamot oil	50 grammes
Artificial musk	2 grammes
Ionon	2 to 5 grammes
Tincture of benzoin	100 grammes

The powder may subsequently be employed for filling cheap sachets, etc.—Deutsche Drogisten Zeitung.

Cement for Porcelain.—An almost invisible joint may be made, with careful handling, with the following:

Chloroform	60 parts.
India rubber	25 parts.
Mastic	15 parts.

Cut the rubber into shreds, put into a suitable vial and pour on the chloroform. Stopper tightly and set aside until the rubber is dissolved, then add the mastic and let stand until the same is dissolved. Apply the cement to each surface to be united and let the pieces stand until the greater part of the chloroform is evaporated, then unite, press firmly to place, and if possible, tie in position. When the cement is apparently thoroughly dry on the surface scrape off the superfluity, and dust over the line of junction a little zinc oxide, chalk, powdered infusorial earth, or some such material, and with a clean pencil brush it over the joint. After the cement has become perfectly dry, remove the cords and rub off the superfluous powder. The joint can scarcely be discovered if the work has been well done.—Phar. Rund.

Bleaching Skin-Salves.—Following are two reliable recipes for skin-creams.

A skin-bleaching action, owing to the presence of hydrogen peroxide, is possessed by the following mixture:

Lanolin	30 grammes
Bitter almond oil	10 grammes

Mix and stir with this salve-base a solution of—

Borax	1 gramme
Glycerin	15 grammes
Hydrogen peroxide	15 grammes

For impure skin the following composition is recommended.

White mercurial ointment	5 grammes
Zinc ointment	5 grammes
Lanolin	30 grammes
Bitter almond oil	10 grammes

And gradually stir into this a solution of—

Borax	2 grammes
Glycerin	30 grammes
Rose water	10 grammes
Concentrated nitric acid	5 drops

In the opinion of the author the bleaching effect of the cream may be ascribed to the nitric acid. This action of the acid is rather well known.

Both salves may be scented with a drop of rose oil.—H. Kuehl in the Pharmaceutische Zeitung.

Paste Polish for Tan Shoes.—

Yellow wax	4 ounces
Oil turpentine	8 ounces

Melt on a water bath, strain, stir occasionally until the paste turns creamy, then add the following solution:

Nankin brown	15 grammes
Phosphin	5 grammes
Water	4 drachms

Stir constantly until the mixture is perfect.—Pract. Drug.

Whooping Cough Sirup.—

Beechwood creosote	10 drops
Camphorated tinct. opium	2 ounces
Sirup dextrine (glucose) sufficient to make	16 ounces

Mix. Directions: A teaspoonful after each paroxysm of coughing.—Pract. Drug.

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